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Volume XI Nos. 2-3

MONTHLY BULLETIN

OF THE

Department of Agriculture

STATE OF CALIFORNIA

WEEDS OF CALIFORNIA

AND

METHODS OF CONTROL

BY

F. J. SMILEY, *Collaborator*

AND

Other Members of the

State Department of Agriculture

SACRAMENTO, CALIFORNIA FEBRUARY-MARCH, 1922

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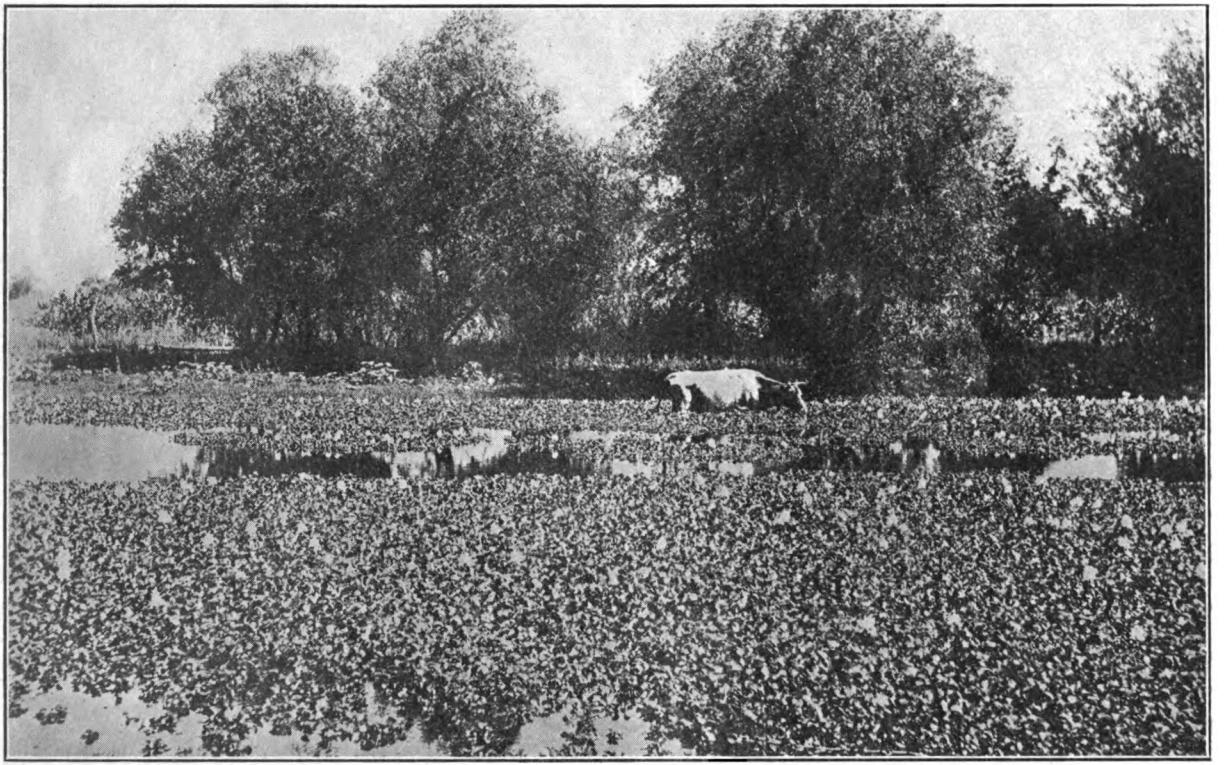

HOW A PLANT BECOMES A WEED.

FIG. 15. The water hyacinth (*Eichornia crassipes*), a cultivated aquatic which runs wild in lakes, lagoons, and slow running streams. It costs the Southern States hundreds of thousands of dollars annually to control this pest. (Fred P. Roullard.)

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Vol. XI. February–March, 1922. Nos. 2–3

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CALIFORNIA STATE PRINTING OFFICE
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THE MONTHLY BULLETIN

DEPARTMENT OF AGRICULTURE

STATE OF CALIFORNIA

DEVOTED TO AGRICULTURE IN ITS BROADEST SENSE, WITH SPECIAL REFERENCE TO PLANT DISEASES, INSECT PESTS, AND THEIR CONTROL.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical, biological and other publications of a similar nature.

G. H. HECKE, Director ..... Censor

BRONTE A. REYNOLDS ..... Editor

Entered as second-class matter October 6, 1919, at the post office at Sacramento, California, under the act of June 6, 1900.

Vol. XI. FEBRUARY–MARCH, 1922. Nos. 2–3

FOREWORD.

It is with a feeling of satisfaction that we issue the first edition of a weed manual compiled to meet California conditions. Several years ago it was apparent to those who studied the agricultural problems of California that weeds were a factor of great importance in relation to yield and cost of production. At that time it was difficult to arouse public interest in control campaigns because the loss from the presence of weeds is not generally visible to the eye but is felt through the reduced vigor and productivity of trees, plants and vines. Among the County Horticultural Commissioners the importance of weeds has been discussed for the past thirty years. In 1914, Mr. H. P. Stabler wrote: "The weed control problem looms large—[It] appeals to me as being one of the most important matters that can engage the attention of the County Horticultural Commissioners. On a ranch of 11,000 acres in this county, two thousand dollars was spent fighting Russian thistle last year and entire crops of grain were lost in parts of the county from the yellow-star thistle."

There has been a tendency of late to systematize and correlate all agricultural activities and recent legislation has made it possible not only to control the spread of those weeds, which have already become established, but also to prevent the further introduction of weeds by cutting off the supply; namely the impurities frequently found in agricultural seeds. The seed testing laboratory has been moved from Berkeley to Sacramento and the Department is now equipped to analyze and test all kinds of commercial seeds.

Thus the future holds forth greater hope for ultimate success in the elimination of the enormous waste which annually results from weed pests than has ever obtained in the past. The problem of weeds has been turned over to the Bureau of Pest Control. A weed survey of the state already has been started and upon its completion we will be in a position to attack the problem with a fairly workable knowledge of local distribution.

There has been an insistent and increasing demand from the farmers of the state for assistance in combating weed pests. By presenting what is now known about California weeds, we hope the interest of farmers and agricultural workers will be stimulated to the further study and observation of them.

G. H. HECKE,
Director of Agriculture.

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EXPLANATION OF CERTAIN COMMON BOTANICAL TERMS USED IN SYSTEMATIC BOTANY.

A—Leafy branch of a *dicotyledonous* shrub bearing a flower-group or *inflorescence* of three flowers.

a. Branch showing five joints or *nodes* where the leaves or bracts are attached; the distance upon the stem between a pair of joints is termed the *internode.*

b. Leaf composed of *blade* or *lamina* with its system of veins or *venation,* leaf-stalk or *petiole,* and pair of *stipules* at base of petiole.

c. Bract; a reduced leaf ordinarily found at the base of an individual flower-stalk; sometimes reduced or gland-like or altogether missing.

d. Flower composed of four sets of *floral organs*: the *calyx* of 4 *sepals* surrounding the base of the *corolla,* which is formed of 4 *petals,* each with an expanded terminal part or *blade* and basal narrow *claw*; 4 *stamens,* each with a slender stalk or *filament* and terminal *anther,* the latter containing the *pollen* within its two *pollen-sacs*; a central solitary *pistil.*

e. Flower partially dissected showing the relation of the floral organs to one another and points of attachment upon the *receptacle* or enlarged tip of the individual flower-stalk or *pedicel.* The three parts of a typical *pistil* are shown: the enlarged basal part or *ovary,* within which the *ovules* ripen into *seeds* as a result of pollination and fertilization, a terminal *stigma* (here represented as 2-lobed) for the reception of the pollen, and a slender intermediate part or *style.* This position of the ovary in the center of the flower and free from all other of the floral organs is said to be *superior* (superior ovaries are present in such common flowers as those of Mustard, Poppy, Buttercup).

f. The flower is a modified *shoot* developed from a *bud* formed in the *axil* of the bract, i. e., within the angle whose sides are the upper surface of the bract and adjacent side of the stem. The corresponding angle in the case of a leaf is termed the *leaf-axil.* In the flowering plants all branches and flowers ordinarily arise only from *axillary buds.*

B—Single *monocotyledonous* flower showing the *perianth* (calyx and corolla taken together) composed of 6 *perianth-segments,* the outer whorl of 3 the shorter, 3 stamens, and central pistil with 3-lobed stigma and *inferior* ovary, the latter with side removed to show the ovules within. When the other floral organs (sepals, petals, stamens) appear to be attached at or above the summit of the ovary, the latter is termed *inferior* (Poet's Narcissus or Iris are examples of flowers with inferior ovaries).

C—The *monocotyledonous* flower with floral organs arranged in whorls of 3 contrasts with the dicotyledonous flower with organs arranged in whorls of 4 or 5. This difference is indicated in the *floral diagram.* The majority of flowers have two whorls of stamens, as shown in the diagram.

D—Diagrams of common types of inflorescence:

a. Raceme: flowers on pedicels of approximately equal length with the oldest flower at the bottom and youngest at the top. In the raceme and in all the other types of inflorescence, the main axis is considered as formed of two parts: that part between the pedicels of the oldest and youngest flowers called the *rachis,* and the part below the lowest pedicel called the *peduncle.*

b. Spike: similar to the raceme but the pedicels reduced or missing, the flowers *sessile* in the bract-axils.

c. Corymb: pedicels unequal in length, the top of the inflorescence flattened with the youngest flowers near the center.

d. Umbel: pedicels about equal in length and appearing attached to the summit of the peduncle; the bracts in the umbel are aggregated into an *involucre* at the top of the peduncle.

e. Head or *anthodium* (the inflorescence of the great Sunflower Family, the largest family of the flowering plants) with sessile flowers upon the enlarged and flattened summit of the peduncle; the bracts of the outermost flowers or undeveloped floral buds constitute the *involucre* enclosing the base of the head.

f. Panicle: a branched raceme.

E—Leaf forms: the first 4 are *simple* leaves, the others *compound* with blades divided into distinct *leaflets.*

a. Grass leaf composed of blade or lamina with a *leaf-sheath* below enveloping the the grass stem or *culm* and between sheath and blade a small scale called the *ligule.* Grass leaves are parallel veined, a kind of venation found in nearly all monocotyledons (lilies, sedges, palms, etc.).

b. Simple netted veined leaf with even margin, slightly heart-shaped or *cordate* base, and bluntly pointed tip—*ovate* leaf. Netted venation is found in nearly all dicotyledons.

c. Oblong leaf.

d. Pinnatifid leaf, the lamina deeply lobed, the lobes appearing more or less distinct from one another.

e. Trifoliate compound leaf formed of three leaflets (example, clover leaf).

f. Pinnate leaf or *pinnately compound* leaf, the blade divided into separate leaflets attached to a *rachis* (example, acacia leaf).

g. Palmately compound leaf, the separate leaflets spreading from the end of the petiole like the fingers of a hand (example, lupine leaf).

When leaves lack petioles, they are said to be *sessile.*

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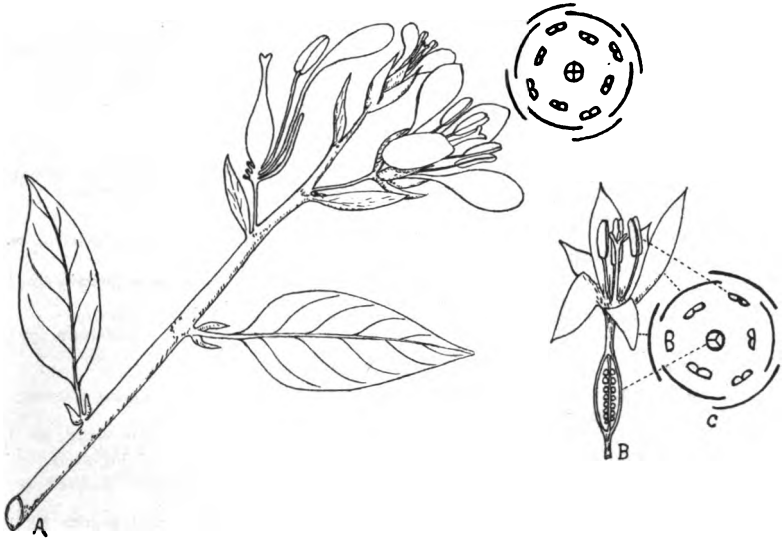

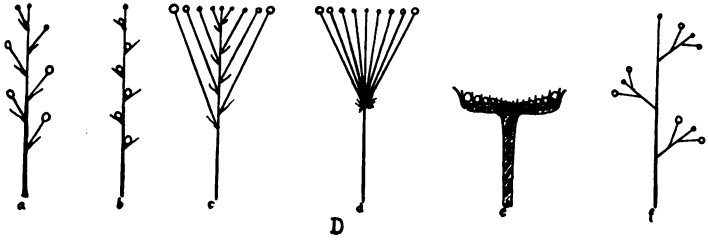

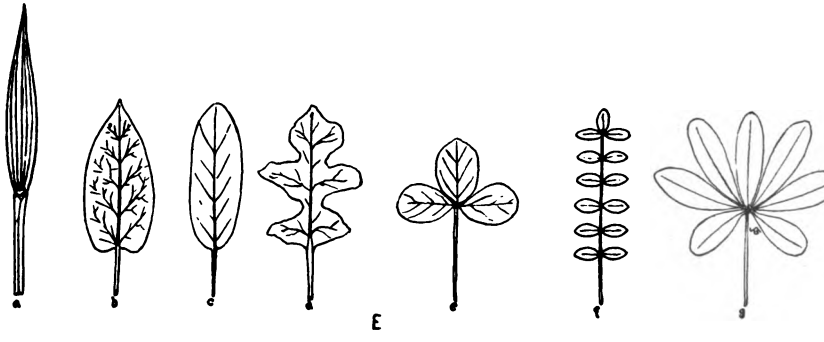

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ARTIFICIAL KEY TO THE MORE IMPORTANT WEEDS OF CALIFORNIA.

1 Plants with wood stems (shrubs or a few sometimes tree-like).

2 Stems conspicuously jointed, flattened and fleshy, armed with spines and prickles; leaves very small, quickly falling; cactus plants.
---------- **California Prickly Pear** (p. 162)

2' Stem joints neither flattened nor fleshy; none cactus-like.

3 Leaves simple (*i. e.*, not composed of distinct leaflets).

4 Flowers very small, greenish or pinkish and singly inconspicuous, grouped in many small heads (*anthodia*); fruits dry, 1-seeded (achenes).

5 Fruit without a tuft of bristles or hairs (*pappus*).

6 Leaves deeply 3-lobed at the squarish summit or some entire, wedge-shaped at base.
---------- **Sage-brush** (p. 163)

6' Leaves entire and thread-like or cut into thread-like segments.
---------- **Old-man** (p. 164)

5' Fruit tipped by a crown of copious hairs (pappus present).

6 Foliage gray, silky-hairy, pointed at both ends of the leaves, their margins even (*entire*).
---------- **Arrow-weed** (p. 137)

6' Foliage green without silky hairs but more or less glandular-sticky.

7 Leaves less than 1" long, wedge-shaped and coarsely toothed or some entire.
---------- **Chaparral-broom** (p. 125)

7' Leaves 2–3" long, willow-like, entire or finely toothed.
---------- **Mule Fat** (p. 125)

4' Flowers large (½–2" across and ½–1" high), not grouped into heads, each on its own pedicel; fruits many-seeded capsules.

5 Corollas greenish-yellow, tubular, contracted near the summit; leaves with petioles half as long as the blades.
---------- **Tree Tobacco** (p. 115)

5' Corollas white or sometimes pinkish, not tubular.

6 Deciduous shrub; petals 1–2" long, one with a large yellow blotch.
---------- **Western Azalea** (p. 115)

6' Evergreen shrub; petals small, less than ⅛" long, all alike.
---------- **Labrador Tea** (p. 108)

5' Corollas lilac or rose-purple, not tubular.

6 Dwarf high mountain shrub rarely 1' high with leaves less than 1" long and lilac flowers about ½" across.
---------- **Pale Laurel** (p. 167)

6' Shrub 3–8' high, with leaves 3–4" long and rose-purple flowers an inch long or longer.
---------- **California Rose-bay** (p. 115)

3' Leaves compound (*i. e.*, formed of distinct leaflets).

4 Stem spiny; flowers pea-shaped, red; fruit a pod; Old-World immigrant.
---------- **Camel's Thorn** (p. 170)

4' Stems without spines; flowers not pea-shaped, white or greenish-yellow; native plants.

5 Leaves trifoliate; flowers very small, greenish-yellow.
---------- **Poison Oak** (p. 128)

5' Leaves composed of many small segments; flowers ½" broad, white.
---------- **Kit-kit-dizze** (p. 142)

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1′ Plants without woody stems (herbaceous annuals and perennials).
2 Grasses or plants of grass-like aspect.
3 True grasses with mostly hollow, round, jointed stems (*culms*), narrow leaves with bases sheathing the stem-joints, the sheaths open on the side opposite the leaf-blades, and small green *naked* (*i. e.*, without calyx or corolla) flowers grouped in *spikelets*, each flower in the axil of a bract.
4 Spikelets grouped in spikes (*i. e.*, an "ear" of wheat) near the top of the culm.
5 Spikes solitary at the top of the culms, their spikelets attached to both sides of the spike-axis (*rachis*).
6 Spikelets solitary in notches at the joints of the rachis, each spikelet flattened.
7 Lateral spikelets place edge-wise against the notch of the rachis, and each with only one empty scale (*glume*) at base.
---------- **Darnel** (p. 133)
7 Lateral spikelets placed edge-wise against the notch of the rachis, and glumes at base.
---------- **Quack-grass** (p. 138)
6′ Spikelets in 3's at each joint of the rachis, only the central spikelet fertile, the lateral reduced to awns ("beards").
---------- **Squirrel-tail grass** and other **Wild Barleys** (p. 6)
5′ Spikes 2–several (5 or 6), their spikelets attached only along one side of the rachis, the spike therefore one-sided.
6 Annual grass without underground rootstocks (*rhizomes*).
---------- **Crab-grass** (p 124)
6′ Perennial grasses with numerous rhizomes.
7 Spikes usually a pair at the top of the culm, rarely a third below; spikelets flattened, somewhat coin-shaped, the flowering-scale (*lemma*) thick and shining.
---------- **Knot-grass** (p. 107)
7′ Spikes, usually several (3–6), spreading from the top of the culm, like the fingers of a hand (*digitately*); spikelets small, pointed, their lemmas neither thick nor shining.
---------- **Bermuda-grass** (p. 8)
4′ Spikelets grouped in *panicles*.
5 Panicles dense, more or less spike-like in appearance, with their branches short and crowded.
6 Panicles one-sided, the spikelets grouped in bunches (*fascicles*) composed of one perfect flower surrounded by several slender empty flowers; panicles golden or purple-tinged.
---------- **Golden-top** (p. 162)
6′ Panicles not one-sided nor their spikelets grouped in fascicles.
7 Panicles bristly, with awns or bristles.
8 Panicles with numerous green or tawny bristles occurring in tufts at the side of the spikelets, the latter awnless.
---------- **Bristly Fox-tail** (p. 110)
8′ Panicles with numerous awns on the scales of the spikelets.
9 Panicles pale green, silvery-shining, narrowly cylindrical.
---------- **Nit-grass** (p. 139)
9′ Panicles tawny, yellowish, or purplish, their branches divergent and panicle form various but not narrowly cylindrical.
10 Spikelets several-awned (5–8); panicles dense, wedge-shaped at base, broadening upward, purple-tinged; awns ½–⅝" long.
---------- **Red Brome** (p. 16)
10′ Spikelets 1-flowered.
11 Panicle branches distinct and panicle lobed, green or purplish; harsh.
---------- **Barnyard-grass** (p. 12)
11′ Panicle dense and appearing continuous, tawny, 1–6" long, soft and plume-like.
---------- **Tawny Beard-grass** (p. 168)

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7′ Panicles not bristly.
8 Herbage soft velvety-hairy; panicle purplish or golden.
---Velvet-grass (p. 149)
8′ Herbage essentially glabrous, never velvety; panicles green or mottled.
9 Flowers imperfect (*i. e.*, pistils and stamens not in the same flower) dicœcious (*i. e.*, staminate and pistillate flowers on distinct plants) grass of saline soils; spikelets several-flowered (6–12) and distinctly separated in the panicle.
---Salt-grass (p. 4)
9′ Flowers perfect and plants all alike; spikelets 1-flowered and closely aggregated in the short, thick spike-like panicle (thyrse).
---Canary-grass (p. 147)
5′ Panicles open-spreading, their branches remote from one another.
6 Panicle composed of 20–40 one-sided spikes branching from a central axis (*rachis*).
---Water-grass (p. 145)
6′ Panicle not composed of one-sided spikes.
7 Spikelets awnless (in orchard-grass the spikelet-scales are pointed—*mucronate*—but not awned).
8 Large water reeds with culms 6–12′ high, the axis of the spikelet bearing many silky hairs longer than the flowers.
---Common Reed (p. 168)
8′ Grasses of dry or moist soil, but never growing in the water, their culms less than 3′ high and spikelets without silky hairs.
9 Perennial grass, forming large dense tufts; culms stout.
---Orchard-grass (p. 170)
9′ Annuals with slender weak culms.
10 Spikelets flattened triangular, broadest at the base, flowering scales papery.
---Small Quaking-grass (p. 146)
10′ Spikelets broadening upward from a narrow base; lemmas green, not papery.
11 Herbage ill-scented when fresh; spikelets 10–40-flowered.
---Stink-grass (p. 138)
11′ Herbage not ill-scented; spikelets 3–6-flowered.
---Walk-grass (p. 139)
7′ Spikelets awned.
8 Annual grasses.
9 Herbage soft and hairy; spikelets 5–7-flowered.
---Broncho-grass (p. 16)
9′ Herbage without hairs (glabrous); spikelets with not more than 3 flowers.
10 Awn at base covered with brownish hairs; leaves 3–8″ long, persistent.
---Wild Oats (p. 116)
10′ Awns without brownish hairs; leaves short (2″ or less), their blades soon falling.
---Silvery Hair-grass (p. 148)
8′ Perennial grasses.
9 Rhizomes many and widely spreading; culms pithy; spikelets occurring in 3's.
---Johnson-grass (p. 14)
9′ Rhizomes absent; culms hollow; spikelets solitary.
10 Awn 3-pronged.
---Needle-grass (p. 146)
10′ Awn undivided.
---Bear-grass (p. 10)
4″ Spikelets enclosed in a hollow, spiny, rounded bur.
---Sand-bur (p. 10)

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3' Plants of grass-like aspect but not true grasses, their stems pithy (not hollow) and leaf-sheaths closed.

4 Stems triangular; flowers in spikelets; perianth wanting.

---Nut-grass (p. 20)

4' Stems round; flowers not in spikelets; perianth composed of 6 segments.

---Yard-rush (p. 145)

2' Herbaceous plants not grasses not of grass-like aspect.

3 Plants producing neither flowers nor seeds, but reproducing by means of *spores* (*i. e.*, minute one-celled bodies produced in great numbers within special receptacles, called *sporangia*).

4 Stems solid, subterranean, and creeping; leaves large, compound, coiled at the tip when young.

---Common Brake (p. 2)

4' Stems of 2 kinds: subterranean and creeping, and erect, both hollow; erect stems either branched and sterile or unbranched and fertile, with a cone at the top, in which the spores are found; leaves reduced to scales.

---Field Horsetail (p. 120)

3' Plants producing both flowers and seeds (True Flowering Plants or *Angiosperms*).

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F—Flowers dark purple to violet ---- xxi
G—Flowers red ---- xxii
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A—Flowers small, green or greenish, the calyx or corolla, if present, not distinctly colored.

1 Water or marsh plants.

2 Stems leafless; flowers in spikelets arranged in umbels.

---Tule (p. 165)

2' Stems leafy, the leaves very long and flat; flowers minute, grouped in dense spikes at the top of the stem.

---Cat-tail (p. 112)

1' Land plants.

2 Herbage clothed with stinging hairs; flowers on string-like slender branches in the leaf-axils.

---Creek Nettle (p. 129)

2' Herbage without stinging hairs.

3 Stipules present and united, forming sheaths (*ochrea*) about the stem-joints.

4 Stems erect, tufted; foliage sour.

---Sheep Sorrel (p. 22)

4' Stems prostrate, forming a mat; foliage not sour.

---Wire-grass (p. 24)

3' Stipules, if present, not united into sheaths about the stem-joints.

4 Flowers in heads (*anthodia*) which are enveloped at base or higher by involucres composed of bracts.

5 Plants annual; involucres of the pistillate heads forming prickly burs.

6 Stems armed with 3-pronged yellow spines.

---Spiny Cocklebur (p. 100)

6' Stems unarmed.

---Common Cocklebur (p. 98)

5' Plants perennial.

6 Rootstocks (rhizomes) absent; prostrate large-sized plant of sand-beaches.

---Beach-bur (p. 132)

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6′ Rootstocks present; plants erect.

7 Leaves deeply pinnatifid; heads of 2 sorts: staminate and pistillate, the former crowded in erect, naked terminal racemes. **Western Ragweed** (p. 135)

7′ Leaves entire; heads all alike, solitary in the upper leaf-axils. **Poverty-weed** (p. 94)

4′ Flowers not in heads.

5 Plants perennial.

6 Leafy stems much branched, the branches prostrate, spreading; flowers not in terminal spikes.

7 Leaves entire or few-toothed; fruit enclosed by a pair of red, fleshy bracts. **Australian Saltbush** (p. 122)

7′ Leaves deeply pinnatifid; fruit enclosed by the dry, veiny calyx; herbage strong-scented. **Cut-leaved Goosefoot** (p. 158)

6′ Leafy stem short, erect, unbranched; flowers in terminal spikes. **Ribwort** (p. 68)

5′ Plants annual.

6 Plants small, the stems prostrate or ascending, less than 6″ long, with all leaves opposite.

7 Leaves awn-shaped, unstalked, their bases united about the stem-joints. **German Knot-grass** (p. 165)

7′ Leaves blunt or rounded at the tip, stalked, their bases not joined.

8 All leaves in pairs, their petioles unequal. **Cypselea** (p. 139)

8′ Some leaves in 4's, petioles short and equal. **Four-leaved All-seed** (p. 164)

6′ Plants larger, the stems erect or ascending, ½–4′ high; all or some of the leaves alternate.

7 Herbage whitened or pale green, never becoming reddish.

8 Herbage white-mealy or pale-green, smooth; flowers perfect and grouped in spikes. **Lamb's-quarters** (p. 28)

8′ Herbage gray, with a dense hairy coating; staminate flowers in terminal corymbs; pistillate flowers few and axillary. **Turkey Mullein** (p. 50)

7′ Herbage green, often becoming reddish.

8 Flowers solitary; mature plant rigid and bushy, sharp spined. **Russian Thistle** (p. 30)

8′ Flowers in terminal or axillary spikes.

9 Fruits wing-margined. **Winged Pigweed** (p. 26)

9′ Fruits without wing-margins.

10 Leaves small, less than 1″ long; branches subequal in length and curving inward. **Tumbleweed** (p. 34)

10′ Leaves larger, 1–4″ long; branches unequal, each with a dense terminal spike of flowers. **Pigweed** (p. 32)

B—Flowers white or greenish-white.

1 Leaves divided into distinct leaflets (compound leaves).

2 Fruit a pod.

3 Flowers pea-shaped; corolla of 5 unequal petals; stamens 10; fruit a *legume*. **Loco-weed** (p. 105)

3′ Flowers not pea-shaped; corolla of 4 equal petals; stamens 6 (4 long, 2 short); fruit a *silique*. **Water-cress** (p. 167)

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2' Fruits not pods.

3 Flowers in heads (*anthodia*) with yellow centers bordered by white rays (daisy-like).

---Mayweed (p. 90)

3' Flowers not in heads but grouped in compound *umbels*.

4 Annual plant, the primary umbel generally of 2 rays (rarely 1 or 3); fruit long-beaked.

---Shepherd's Needle (p. 160)

4' Biennial or perennial plants with primary umbels formed of 3–several rays, each with a small umbel at its tip.

5 Leaves trifoliate, each leaflet 3–6" broad, its margins sharply toothed; petioles whitish, much inflated about the stem joints.

---Cow-parsnip (p. 168)

5' Leaves composed of many leaflets.

6 Perennial glabrous native marsh herb, the stems 3–5' high from short erect *chambered* rootstocks.

---Water Hemlock (p. 113)

6' Biennial herbs without rootstocks; garden escapes.

7 Root system fibrous, composed of many cord-like brown roots; plant smooth.

---Celery (p. 167)

7' Tap-rooted plant with stems harsh with stiff hairs; fruiting umbel shaped like a bird's nest.

---Wild Carrot (p. 161)

1' Leaves simple, not divided into distinct leaflets, though often deeply lobed (pinnatifid).

2 Twining parasites with yellow silky thread-like stems and minute scale leaves (apparently leafless).

---Dodder (p. 58)

2' Plants not parasitic, their foliage of small to good-sized green or greenish leaves.

3 Leaves with entire or even margins.

4 Leaves opposite or in whorls.

5 Perennials with milky juice; stems 2–4' high, erect.

---Common Indian Hemp (p. 153)

5' Annuals without milky juice; stems shorter, prostrate, sprawling or ascending.

6 Stem leaves 2, united by their bases to form a more or less circular disk about the stem.

---Miner's Lettuce (p. 140)

6' Stem leaves several to many, their bases not joined.

7 Leaves appearing in whorls of 5 or 6.

8 Petals none, the sepals whitened within; plant forming mats.

---Carpet-weed (p. 109)

8' Petals present; stems ascending.

---Corn Spurry (p. 140)

7' Leaves in pairs.

8 Stems reclining, rooting at the joints; leaves petioled; petals divided nearly to the base into narrow lobes.

---Common Chickweed (p. 106)

8' Stems ascending, 3–6" tall; leaves sessile; petals merely notched at the apex.

---Mouse-ear Chickweed (p. 150)

4' Leaves alternate or in spirals.

5 Leaves parallel-veined and somewhat grass-like; flowers with perianth of 6 segments; plants growing from bulbs.

---Death Camas (p. 121)

5' Leaves netted-veined; flowers with calyx and corolla of 4 or 5 segments each (except *Tibinagua*), or with corolla wanting (*Yerba Mansa* really has naked flowers, but is here included because of the white bracts).

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6 Flowers grouped in spikes.

7 Marsh plant with aromatic rootstock; flowers without calyx or corolla, grouped in a thick, solitary symmetrical spike on the end of the hollow erect stem and surrounded at base by 5–7 white waxy bracts.

---------- **Yerba Mansa** (p. 166)

7′ Plant often growing in moist soil, but not in marshes; flowers in one-sided coiling spikes, the latter usually in pairs.

---------- **Wild Heliotrope** (p. 62)

6′ Flowers not in spikes.

7 Plants twining; flowers generally solitary, sometimes 2 or 3 together.

---------- **Orchard Morning-glory** (p. 56)

7′ Plants not twining.

8 Stems reedy, leafless at time of flowering; flowers in heads.

---------- **Mexican Devil-weed** (p. 76)

8′ Stems not reedy nor leafless; flowers not in heads.

9 Corolla absent, the calyx 6-parted and stamens 9; flowers in small, clustered involucres.

---------- **Tibinagua** (p. 169)

9′ Corolla present; flowers solitary in terminal racemes or in the leaf-axils.

10 Stems tall, 2–5′ high, not tufted; flowers in terminal racemes, the petals distinct and ovary inferior.

---------- **Velvet-weed** (p. 110)

10′ Stems low, 6″ or less high, tufted; flowers in the leaf-axils, the petals united and ovary superior.

---------- **Cressa** (p. 161)

3′ Leaf-margins not entire but toothed, scalloped, lobed, or deeply cut (pinnatifid).

4 Leaf-margins toothed, scalloped, or lobed, but not pinnatifid.

5 Trailing or climbing tendril-bearing vine with ivy-like, green, thin, 5–7-lobed leaves and monoecious flowers in the leaf-axils.

---------- **Common Man-root** (p. 106)

5′ Plants not vine-like and never bearing tendrils.

6 Leaves all opposite.

7 Stems round, prostrate or creeping, not white-woolly.

8 Annual plant with milky juice; leaves blotched with red and toothed to the heart-shaped base.

---------- **Spotted Spurge** (p. 143)

8′ Perennial plant without milky juice; leaves not red-blotched, toothed only above the middle, their bases wedge-shaped.

---------- **Mat-grass** (p. 161)

7′ Stems square, erect, white-woolly.

---------- **Horehound** (p. 131)

6′ Leaves all or nearly all alternate (Neckweed has its few lowest leaves opposite, all upper alternate).

7 Flowers solitary in the leaf-axils or stem forks and always few, their corollas ½″ broad or broader.

8 Fetid coarse herb, 1–5′ high; corolla-tube slender, 4–5″ long; fruit an oval prickly pod, 2″ long.

---------- **Jimson-weed** (p. 107)

8′ Small scentless herb, scarcely 1′ high; corolla with short, flaring tube; fruit a berry enclosed by the bladdery persistent calyx.

---------- **Ground Cherry** (p. 154)

7′ Flowers grouped in heads or racemes, numerous; corollas less than ¼″ broad.

8 Flowers very small, in numerous panicled *heads* at the top of the 2–5′ tall simple stem; fruit an achene.

---------- **Horseweed** (p. 102)

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8′ Flowers larger, in *racemes* or *panicles*, each on its own pedicel; stems less than 2′ tall; calyx and corolla each 4-parted; fruit a pod.

9 Pod wing-margined, notched at the apex.
---Field Pennycress (p. 104)

9′ Pod without a wing-margin, its summit tipped by the slender style.
---Hoary Cress (p. 44)

4′ Leaves pinnatifid, some of their lobes appearing as nearly distinct leaflets; calyx and corolla 4-parted; fruit a pod.

5 Plant prostrate, fetid; stamens usually 2 or 4; pod round and wrinkled, separating into a pair of 1-seeded nutlets.
---Wart-cress (p. 158)

5′ Plant erect, not fetid; stamens always 6 (4 long, 2 short); pod wedge-shaped, flattened, many-seeded.
---Shepherd's Purse (p. 136)

C—Flowers greenish-yellow or yellow.

1 Leaves simple, not composed of distinct leaflets.

2 Flowers not grouped into heads (*anthodia*).

3 Plants annual, dying after fruiting (occasionally a few persisting into a second season in the warmer parts of the state).

4 Plants with prickly or spiny stems or foliage.

5 Corolla composed of 4 (or 6) distinct petals; stamens numerous and free from the petals.
---Mexican Prickly Poppy (p. 151)

5′ Corolla composed of 5 united petals; stamens 5, attached to the tube of the corolla.
---Buffalo-bur (p. 130)

4 Plants not prickly.

5 Leaves all entire, wedge-shaped; fleshy prostrate herb, with flowers opening only in the sunshine.
---Common Purslane (p. 108)

5′ Leaves not entire, their margins toothed, lobed, or deeply cut; plants neither fleshy nor prostrate, their stems erect or ascending.

6 Leaves palmately deeply cut into 3 to 5 lobes; petals 6 to 7 and stamens many; fruit an achene.
---Cursed Crowfoot (p. 152)

6′ Leaves not palmately cut, their blades laterally toothed or lobed (pinnatifid leaves); petals always 4 and stamens 6 (4 long, 2 short); fruit a pod.

7 Leaves merely toothed.
---False Flax (p. 147)

7′ Leaves pinnatifid.

8 Pods flattened and 2-sided, sometimes twisted.
---Wormseed Mustard (p. 141)

8′ Pods round or 4-angled.

9 Flowers ¼–⅜″ across; pod with a sterile, spongy beak.
---Black Mustard (p. 38)

9′ Flowers ⅛″ across; pods not beaked.
---Hedge Mustard (p. 42)

3′ Plants biennial or perennial.

4 Prostrate, rough hairy vine, tendril-bearing, with monoecious flowers and gourd-like fruits.
---Calabazilla (p. 111)

4′ Plants not vines nor tendril-bearing, their flowers perfect and fruits various but never gourd-like.

5 Leaves entire or merely toothed, never pinnatifid; herbage not glandular, fragrant.

6 Floating aquatic or mud-bank herb, the sprawling stems 1–6″ long; fruit (capsule) with a 5-pointed crown.
---Yellow Waterweed (p. 165)

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6′ Plants not aquatic, their stems erect or ascending.

7 Leaves large, clasping the coarse stout stem, parallel-veined; flower with a 6-parted greenish-yellow perianth.
---------- **California False Hellebore** (p. 166)

7′ Leaves smaller, not clasping the slender stems; flowers with distinct calyx and corolla, the latter bright yellow or turning reddish.

8 Corolla 5-parted.

9 Petals distinct, black-dotted; stamens numerous, their filaments naked.
---------- **Common St. John's-wort** (p. 54)

9′ Petals united to a short tube; stamens 5, their filaments with violet woolly hairs.
---------- **Moth Mullein** (p. 153)

8′ Corolla 4-parted.

9 Stems 1–6′ high.

10 Flower 2″ across, its corolla fading reddish and *inferior* ovary becoming a capsule.
---------- **Evening Primrose** (p. 150)

10′ Flower less than ½″ across, the *superior* ovary becoming a pod.
---------- **Woad** (p. 134)

9′ Stem very short, but rising above the ground and crowned by the rosette of leaves; flowers appearing stalked, but the "stalk" really the much-elongated calyx-tube.
---------- **Golden Eggs** (p. 151)

5′ Leaves pinnatifid, with many club-shaped segments, the foliage glandular, scented with pellucid dots, fragrant when bruised.
---------- **Common Rue** (p. 136)

2′ Flowers grouped into heads (*anthodia*)—all belonging to the Sunflower Family.

3 Plants annual.

4 Herbage prickly or spiny; plants usually thistle-like.

5 Flowers of the head all alike, without distinction of ray or disk-florets; plants not glandular-viscid.

6 Stem-leaves entire, narrow-linear, their bases decurrent on the stems as narrow wings; stems branching from the base, more or less cottony; heads with simple, spreading stout spines, ½–1″ long.
---------- **Yellow Star Thistle** (p. 80)

6′ Stem-leaves without decurrent bases, their margins toothed or lobed, spine-tipped; heads without spreading simple spines.

7 Stems simple or rarely few-branched above; heads clustered and not surrounded by the upper leaves; involucral bracts without spines; herbs with milky juice.
---------- **Spiny Sow Thistle** (p. 78)

7′ Stems much branched above; heads solitary at the ends of the branches, surrounded by the clustered upper leaves; inner involucral bracts tipped with branching spines; herbs without milky juice.
---------- **Blessed Thistle** (p. 126)

5′ Flowers of the head of two kinds; bordering ray surrounding the central disk-florets; plants glandular-viscid.
---------- **Common Spikeweed** (p. 70)

4′ Herbage not prickly or spiny; plants not thistle-like.

5 Leaves entire or toothed, but never deeply pinnatifid; involucral bracts not black-tipped.

6 Herbage glandular-viscid.
---------- **Tarweed** (p. 72)

6′ Herbage not glandular-viscid.

7 Stems generally less than 2′ in height.

8 Herbage essentially glabrous; fruits (achenes) crowned with copious, soft white hairs (*pappus*).
---------- **Smooth Hawksbeard** (p. 156)

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8′ Herbage soft-hairy; achenes forming a ball 1–1.5″ across, very conspicuous, with the silvery-shining pappus scales.
---Blow-wives (p. 163)

7′ Stems becoming 2–6′ in height.

8 All leaves petioled, green, and harsh with short stiff hairs; pappus composed of few scales.
---Common Sunflower (p. 84)

8′ Upper leaves sessile, their bases twisted; pappus composed of numerous red-brown rough hairs.
---Telegraph Plant (p. 96)

5′ Leaves pinnatifid; involucral bracts black-tipped.
---Common Groundsel (p. 123)

3′ Plants perennial.

4 Herbs with milky juice; flowers of the head all alike, without distinction of ray or disk-florets.

5 Plants 2–5′ high, bristly or prickly.

6 Stems harsh with barbed hairs; bracts of the involucre in two series: the outer shorter and merely pointed, the inner longer and slenderly branching above; fruits without a beak bearing the pappus.
---Bristly Ox-tongue (p. 86)

6′ Stems nearly smooth; bracts similar; fruits with slender beaks bearing the pappus.
---Prickly Lettuce (p. 82)

5′ Plants less than 2′ high .

6 Flowering stems (*peduncles*) hollow.
---Common Dandelion (p. 155)

6′ Flowering stems solid.

7 Flowering stems branched, the heads terminal on the branches.
---Hairy Cat's-ear (p. 92)

7′ Flowering stems unbranched, each bearing a single head.
---Hairy Agoseris (p. 163)

4′ Herbs without milky juice.

5 Heads without ray-florets.

6 Stems erect, 2–6′ high; leaves white-downy underneath; heads in spikes.
---California Mugwort (p. 117)

6′ Stems trailing, scarcely 1′ long; herbage glabrous, often fleshy; heads solitary on long, naked stalks.
---Brass Buttons (p. 117)

5′ Heads with ray-florets.

6 Herbage glabrous; heads large, when young exuding a white secretion.
---White-stemmed Gum-plant (p. 162)

6′ Herbage gray-hairy, with minute hairs; heads small, very numerous, in a dense terminal panicle.
---Common Goldenrod (p. 155)

1′ Leaves compound, composed of distinct leaflets.

2 Leaves 3- or 5-foliate.

3 Leaves always trifoliate (3 leaflets); flowers not in heads (*anthodia*).

4 Fruit a pod (legume) and flowers pea-shaped.

5 Flowers in short dense spikes; pod curving, kidney-shaped; stems reclining.
---Nonesuch (p. 118)

5′ Flowers in racemes; pods straight; stems erect.
---Sour Clover (p. 134)

4′ Fruits not pods (legumes) nor flowers pea-shaped.

5 Ill-scented annual with erect stems 2–4′ high; flowers with stamens long-protruding, grouped in dense terminal racemes.
---Stink-weed (p. 159)

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5' Fresh-scented, small, perennial, spreading by rootstocks, the stems scarcely 6" long; flowers with stamens not protruding, grouped in pairs of 3's in axillary clusters.
---Yellow Sorrel (p. 156)

3' Leaves 3- or 5-foliate; flowers in heads; erect branching herb 2–5' tall, the fruit an achene with a pair of erect barbed awns.
---Beggar-ticks (p. 159)

2' Leaves many-foliate (leaflets always more than 5).

3 Flowers pea-shaped; fruit a pod (legume).

4 Stems 1' long or less, reclining or ascending; leaves twice compound and glandular.
---Pignut (p. 164)

4' Stems 5–10' tall; leaves simply compound, not glandular.
---Indian Hemp (p. 153)

3' Flowers not pea-shaped.

4 Perennial or biennial herbs.

5 Plant not more than 2' high; leaves large, 3-parted, each part many times dissected; flowers large, ½–2" across, solitary or 2 or 3 together.
---California Poppy (p. 141)

5' Plants more than 2' high, often 4 to 7 feet; flowers small, grouped in large compound umbels.

6 Leaves twice compound (*bipinnate*), their ultimate segments thread-like, entire; herbage aromatic.
---Sweet Fennel (p. 111)

6' Leaves once-compound (pinnate), the leaflets 3–4" long, with sharply-toothed margins; herbage faintly scented.
---Common Parsnip (p. 160)

4' Annual herbs with simply compound leaves.

5 Hairy, much-branched mat-forming plant producing stout-spined burs; flowers solitary, not in heads.
---Ground Bur-nut (p. 48)

5' Glabrous branching herb with stems ascending, 2–10" high; herbage fragrant; flowers in long-stalked rayless heads (*anthodia*).
---Pineapple-weed (p. 145)

D—Flowers pinkish-white to pink or light purple.

1 Leaves opposite.

2 Stems 2–5' high, erect, usually unbranched (simple).

3 Plant with milky juice; stem leaves short-petioled; herbage white-woolly; flowers pink to reddish-purple, in large umbels.
---Creek Milkweed (p. 66)

3' Plant without milky juice; stem leaves united by their bases to form cups about the stem joints; herbage glabrous; flowers light pink, in a dense terminal stout spike surrounded at base by curving spiny bracts.
---Fuller's Teasel (p. 114)

2' Stems 2' high or less, erect or ascending, sometimes decumbent at base.

3 Stems square (4-angled), rough on the edges, with downward pointing stiff hairs; leaves coarsely scalloped, cordate at base; flowers purplish, clustered in the leaf-axils.
---Hedge Nettle (p. 64)

3' Stems round; leaves entire; flowers in terminal spikes or broad clusters.

4 Plant hairy, somewhat glandular; flowers in 1-sided racemes, pale pink or flesh-colored.
---Windmill Pink (p. 36)

4' Plant glabrous; flowers in open terminal clusters, their corollas of united petals bright pink with yellow center.
---Canchalagua (p. 153)

1' Leaves alternate.

2 Flowers in heads (*anthodia*).

3 Heads without ray-flowers; coarse biennial 3–7' high, with large leaves, producing pink or purplish flowers inside the bur-like involucres.
---Common Burdock (p. 127)

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3' Heads with ray-flowers.

4 Leaves simple, entire or finely few-toothed; heads in a narrow panicle, their rays light pinkish-purple and disk-flowers yellow.
---------- **Slender Aster** (p. 157)

4' Leaves compound, with many small segments; heads in a terminal corymb; rays very light pink or nearly white, disk-flowers yellow.
---------- **Yarrow** (p. 164)

2' Flowers not in heads.

3 Corolla of distinct petals; stamens more than 4.

4 Flowers in small axillary clusters, pink; stamens many, their filaments united to form a tube about the several styles.
---------- **Cheeseweed** (p. 109)

4' Flowers in large, free-branching terminal racemes; corollas purple to pink or nearly white, veiny; stamens 6 (4 long, 2 short), their filaments distinct.
---------- **Wild Radish** (p. 40)

3' Corolla of united petals, the tube red-spotted within; stamens 4; tall leafy biennial.
---------- **Purple Foxglove** (p. 157)

E—Flowers cream-colored to orange.

1 Plants prickly-stemmed and leaves spinescent, their margins coarsely-toothed or pinnatifid; flowers large, 1–2″ across.
---------- **Mexican Prickly Poppy** (p. 151)

1' Plants not prickly; leaves entire or with a few shallow lobes; flowers smaller, never exceeding an inch across, usually much smaller.

2 Plant less than 1' high, widely branching, with round or kidney-shaped leaves, the herbage covered with yellow wool; flowers axillary, their petals free; stamens united by their filaments to form a tube about the several styles.
---------- **Alkali Mallow** (p. 52)

2' Plant 1–4' high, erect; leaves narrow strap-shaped, the herbage bristly-hairy but not woolly; flowers in terminal 1-sided coiled spikes, corollas cream-colored to orange.
---------- **Buckthorn-weed** (p. 60)

F—Flowers dark purple to violet.

1' Floating aquatic with short stems and broad, green parallel-veined leaves, their petioles inflated and bladdery; flowers violet, the largest of the 6 perianth segments yellow-blotched.
---------- **Water Hyacinth** (p. 169)

1' Plants not floating aquatic, growing in dry or moist soil.

2 Flowers not in heads.

3 Corolla of free petals; flowers not in spikes nor in the axils of colored lobed bracts.

4 Leaves opposite; flowers solitary or in umbels.

5 Leaves entire; flowers dark purplish, solitary and long-stalked.
---------- **Corn Spurry** (p. 140)

5' Leaves pinnatifid or pinnate; flowers rose-purple to violet, grouped in few-flowered (1–3) umbels.
---------- **Filaree** (p. 142)

4' Leaves alternate; flowers in racemes.

5 Leaves simple, nearly entire; flowers lilac-purple, not pea-shaped; ovary inferior and appearing like a pedicel.
---------- **Fireweed** (p. 148)

5' Leaves palmately compound, 6–9-foliate; flowers deep violet, pea-shaped, their ovaries superior and becoming pods.
---------- **Summer Lupine** (p. 151)

3' Corolla of united petals; flowers numerous, densely aggregated into terminal spikes, each flower in the axil of a deeply-lobed crimson or purplish bract.
---------- **Owl's Clover** (p. 154)

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2′ Flowers in heads (all but the first true *anthodia*).

3 Leaves opposite, some compound; heads on long, naked stalks, but the bracts of the involucre not long-pointed and so overtopping the heads.
---Mourning Bride (p. 157)

3′ Leaves alternate, none compound; heads true anthodia.

4 Plant with milky juice and long grass-like leaves; heads on long stalks and overtopped by the green long-pointed bracts.
---Salsify (p. 158)

4′ Plants without milky juice; leaves coarsely toothed or pinnatifid, prickly and thistle-like.

5 Leaves green, not white-blotched, their bases running down the stems; heads higher than broad, the bracts cobwebby and tipped by slender, ascending rigid prickles.
---Bull Thistle (p. 74)

5′ Leaves white-blotched between the veins, not decurrent on the stems; heads solitary, broader than high, the bracts without cobwebby hairs, tipped with stout, spreading and recurving spines.
---Milk Thistle (p. 88)

G—Flowers red.

1 Leaves entire, sessile or without distinct petioles.

2 Leaves alternate; crimson flowers in leafy racemes, their sepals 2 and petals 5, free from each other.
---Red Maids (p. 140)

2′ Leaves opposite or rarely whorled; brick-red or salmon-colored flowers in the leaf-axils, sepals and petals both 5, the petals united at base.
---Pimpernel (p. 133)

1′ Leaves deeply lobed or divided (compound), all petioled.

2 Stems round; leaves palmately deeply cut, without tendrils; flowers in umbels in the leaf-axils, corolla rose-colored, not pea-shaped.
---Common Cranesbill (p. 146)

2′ Stems angled; leaves divided into paired leaflets and ending in coiling tendrils; flowers solitary or in pairs in the upper leaf-axils, their corollas pea-shaped, purple-red.
---Common Vetch (p. 148)

H—Flowers blue or lavender.

1 Flowers not in heads (*anthodia*).

2 Leaves all opposite; herbage gray-hairy.

3 Leaves entire, unstalked, their tips pointed; flowers on the leaf-axils, the corolla with slender, curving upper lip and long protruding stamens; herbage glandular, strong scented.
---Vinegar Weed (p. 144)

3′ Leaves jagged-toothed, stalked, with blunt tips; flowers in dense, slender terminal spikes, their stamens not protruding.
---Common Vervain (p. 131)

2′ Leaves all or mostly alternate.

3 Flowers in racemes.

4 Annual or biennial, 2′ high or less; leaves entire, sessile; stamens 4.
---Blue Toad-flax (p. 156)

4′ Perennial, 2–6′ high; leaves palmately deeply 5–7-lobed, petioled; stamens many.
---Larkspur (p. 119)

3′ Flowers in bur-like, bracted terminal clusters; leaves pinnatifid, their segments rigid-spiny; plant hairy and viscid-glandular, ill-scented.
---Skunk-weed (p. 116)

1′ Flowers not in heads.

2 Slender herb with milky juice, not thistle-like; stem leaves entire, reduced and bract-like; herbage green.
---Chicory (p. 144)

2′ Stout herb without milky juice, thistle-like; stem-leaves pinnatifid, their lobes spiny; herbage whitened or hoary.
---Artichoke (p. 126)

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GROUP I
THE MOST INJURIOUS WEEDS

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GROUP I

THE MOST INJURIOUS WEEDS

By F. J. SMILEY, Collaborator.[1]

COMMON BRAKE.

(*Pteris aquilina* L.)

English names: (1) Common Brake; (2) Bracken; (3) Hog Brake; (4) Adderspit; (5) Eagle Fern.

DESCRIPTION.

Habit: Perennial herb with slender branching and widely spreading underground creeping stems, bearing fibrous roots on their lower surfaces and large compound green leaves above. *Leaves* on long, slender, straw-colored stalks (stipes), 1 to 3 feet in length, leaf blades triangular in outline, 1 to 3 feet long and nearly as broad, composed of a dozen or more lateral leaflets, the lower of which are again subdivided. Leaflets deeply lobed below the apex, the lobes all blunt and more or less hairy on the lower surface. Reproducing by means of spores developed in small brown spore-cases (sporangia) densely clustered along the edges of the leaflets on the under side.

DISTRIBUTION.

The Common Brake is distributed all over the world and frequently becomes a weed of pastures and cultivated fields, especially in regions with cool summers. In California, the brake is one of the serious pests infesting tilled lands and permanent pastures in the coast counties. It is reported to be particularly troublesome in Santa Cruz County.

CONTROL.

Experiments conducted by the Office of Farm Management of the Department of Agriculture and reported by H. R. Cox in Farmers' Bulletin No. 687 (1915) indicate certain methods which have been found effective in eradicating brakes from lands in the east and which are doubtless of value in California. These experiments show that this fern can be controlled by (a) mowing the fronds before the spores mature in the late summer and autumn; (b) salting the ferns and then running stock upon the infested land; (c) cultivation through two growing seasons; and finally (d) by the use of a spray of a solution of common salt. The bulletin may be obtained by addressing the Superintendent of Documents, Government Printing Office, Washington, D. C.

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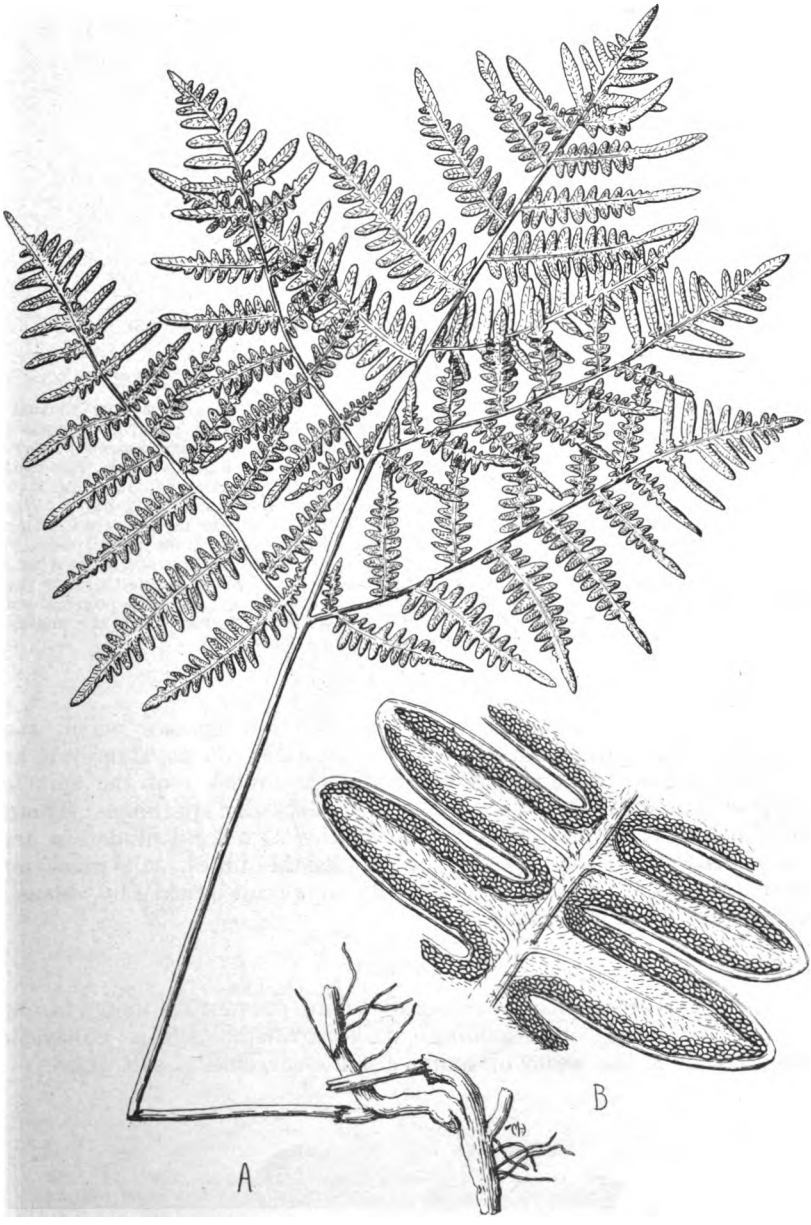

FIG. 16. Common Brake (*Pteris aquilina*): A, Leaf (frond) of the common brake showing the long stalk and compound blade formed of many leaflets; B, Underside of a section of a leaflet showing the densely clustered spore-cases (sporangia) at the margins of the lobes.

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SALT GRASS.

(*Distichlis spicata* Greene.)

English names: (1) Salt Grass; (2) Marsh Spike Grass.

DESCRIPTION.

Habit: Perennial grass with widely spreading, stout, creeping stems, rooting at the joints and bearing numerous erect culms from the axils of its stiff, smooth and pointed scale leaves. Culms smooth, 4 to 12 inches high, bearing numerous narrow, flat or rolled leaves, one-half to 4 inches long and more or less distinctly two-ranked with leaf sheaths about half as long as the blades and closely infolding the stems; ligule at junction of blade and sheath formed of a ring of white crinkly hairs. *Stems* and *leaves* completely glabrous, bluish-green in color or the stems straw colored. *Flowers* imperfect (i.e., unisexual), containing either stamens or ovary, each kind on distinct plants (plants dioecious), grouped in flattened spikelets clustered at the tops of the culms or one or two smaller spikelets below; spikelets one-third to three-fourths inch long, 4 to 18 flowered, their bases enclosed by 2 empty pointed scales (glumes), the flowers in the axils of the upper scales (lemmas); all the scales at first pale green but becoming purplish as the grains mature.

DISTRIBUTION.

Salt Grass is one of the comparatively few grasses which show separately sexed individuals. The two kinds of plants, staminate and pistillate, appear alike superficially and examination of the spikelets is required to establish the nature of any particular specimen. Though possessing some forage value and of service as a sand binder in arid, windy districts of the interior or on coastal dunes, salt grass may become a nuisance because of its ability to spread quickly by means of its creeping stems (rhizomes).

CONTROL.

Control measures must be directed toward preventing these rhizomes from maintaining or resuming active growth. Clean cultivation through four or six weeks of summer will clear land of salt grass.

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FIG. 17. Salt Grass (*Distichlis spicata*): A, Habit showing rhizome with terminal buds and erect shoots, two of the latter bearing spikelets. B, Single spikelet of male plant.

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SQUIRREL-TAIL GRASS.

(*Hordeum jubatum* L.)

English names: (1) Squirrel-tail Grass; (2) Wild Barley; (3) Tickle Grass; (4) Flicker-tail; (5) Skunk-tail.

DESCRIPTION.

Habit: Perennial grass with erect, slender culms or the culms more or less creeping at base but rising to a height of 1 to 2 feet. *Leaf-sheaths* loosely enfolding the culms, smooth and glabrous and generally shorter than the internodes. Blades 1 to 6 inches long and one-eighth to one-fourth inch wide, harsh to the touch, the ligule short. *Flowers* in spikelets which are grouped into soft, nodding spikes at the tops of the culms, 2 to 4 inches long and an inch broad, with the central axis flattened and conspicuously jointed. *Spikelets* 1-flowered, occurring in threes at each joint of the spike, the lateral spikelets changed to slender spreading rough awns (beards) about 1 to 1.5 inches long, the central grain-bearing spikelet also having its scales (glumes and lemma) awnlike, 1 to 1.5 inches long. When the grain is mature, the axis of the spike breaks at the joints and each group of three spikelets (2 infertile and 1 fertile) becomes separate.

DISTRIBUTION.

The name "Wild Barley" as used in California includes a number of distinct grasses, all belonging to the genus *Hordeum,* of which one species, *H. vulgare,* is cultivated barley. The following key distinguishes these "wild barleys:"

Key to the Wild Barleys.

Annual plants with awns (beards) less than an inch long.
  Lower leaves and sheaths more or less soft-hairy (pubescent)--*H. gussoneanum*
  All leaves and their sheaths smooth or bearing short, stiff hairs, and their surfaces harsh to the touch (scabrid).
    Sheaths and blades smooth----------*H. murinum*
    Sheaths and blades scabrid----------*H. nodosum*
Perennials with lateral spikelets reduced to awns (beards) 1 to 2.5 inches long--
  ----------*H. jubatum*

CONTROL.

All of the weedy grasses above distinguished resemble one another and may be controlled by the same methods. Stirring the ground by cultivation cuts off their water supply and they quickly dry up and die. Roadside patches should be mowed, the tops allowed to dry and then burned. Smaller clumps in dooryards and gardens should be hoed out before the spikelets mature.

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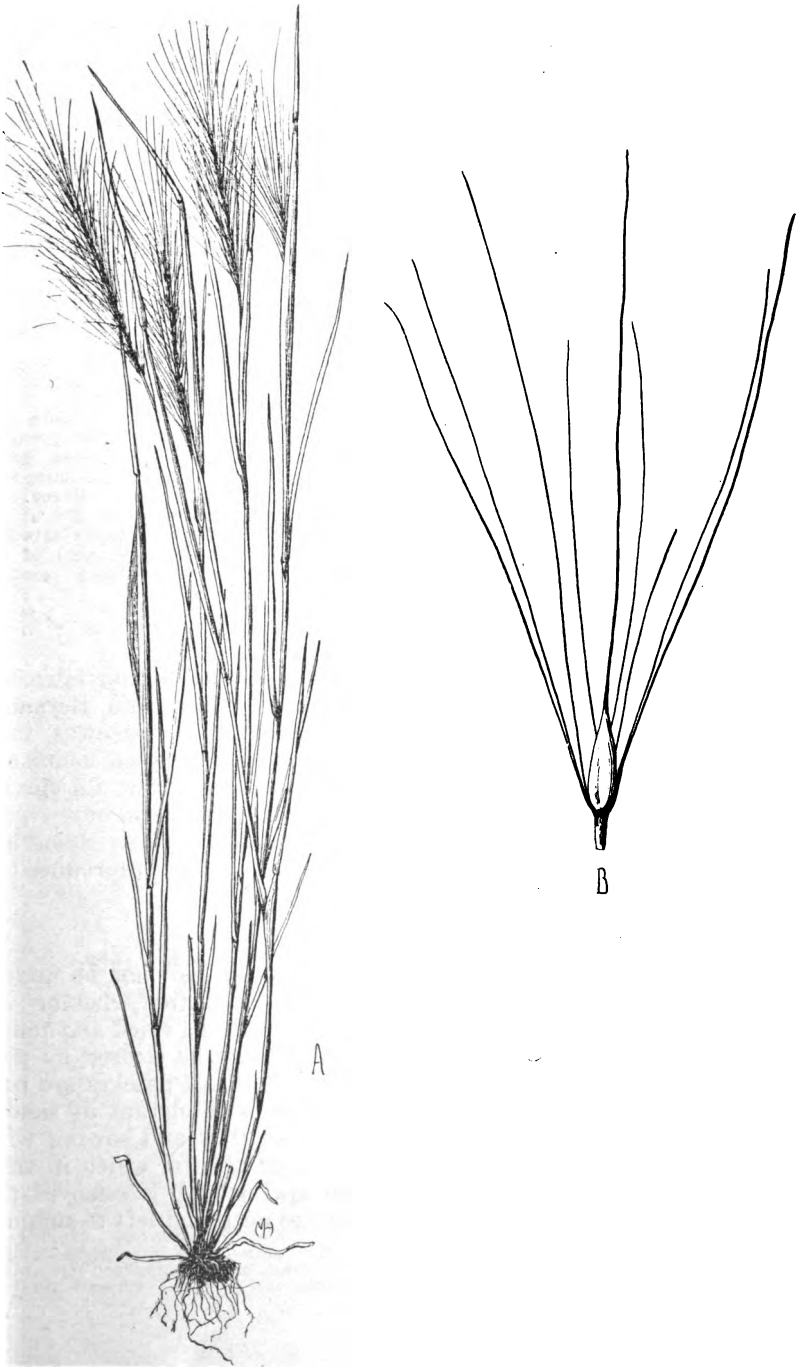

FIG. 18. Squirrel-tail Grass (*Hordeum jubatum*): A, Habit. B, Group of three spikelets enlarged to show the fertile, central, grain-bearing one and the two lateral spikelets reduced to long "beards."

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BERMUDA GRASS.

(*Cynodon dactylon* [L.] Kuntze.)

English names: (1) Bermuda Grass; (2) Scutch-grass; (3) Dog's-tooth Grass; (4) Wire-grass; (5) Devil's-grass.

DESCRIPTION.

Habit: Perennial grass with long, creeping, jointed stems often several feet in length, freely rooting at the nodes and bearing short, broad, thick, scale-like leaves (undeveloped leaf-sheaths), from the axils of which arise the erect culms. Erect flower-bearing culms 4 to 18 inches high, somewhat flattened, wiry, smooth and glabrous, formed of short internodes and bearing a number of obviously 2-ranked leaves. *Leaves* with short sheaths and flat, rigid blades, 1 to 4 inches long, harsh on the upper surface but smooth below. Ligule seen as a ring of white hairs surrounding the culm. *Flowers* in spikelets which are arranged in 2 rows (alternately) on one-sided spikes, ½ to 2 inches long, occurring in groups of three or five at the summits of the erect culms. *Spikelets* single-flowered and flattened, closely attached to the axis of the spike and slightly overlapping. Empty scales (glumes) of the spikelets unequal, narrow, conspicuously keeled; the fertile scale (lemma) oval in shape and one-third longer than the pointed glumes.

DISTRIBUTION.

Though a valued forage grass in the southern states and esteemed both as a pasture and lawn grass in some parts of California, Bermuda grass may become a serious pest in cultivated lands or in lawns, then perhaps meriting the name "Devil's-grass" by which it is so commonly known in many places. The plant seeds abundantly but its spread is mainly effected by the long, wiry rhizomes which may run out several feet from the parent crown, rooting at each joint. These stems are easily broken up at the joints and each segment is able to reproduce the entire plant.

CONTROL.

Wherever Bermuda is obnoxious, its eradication can not be undertaken too soon, since it speedily forms a dense, thick turf, choking out nearly all other vegetation. This turf may become so thick and tough as to require a heavy plow to break it. Land can be cleared by persistent cultivation but the labor cost is heavy. Small patches are best covered with straw and fired. Bermuda grass is intolerant of shade; infested land may be reclaimed by plowing shallow and sowing with some rapid growing crop, like cow-peas or even alfalfa, which in time will smother out the Bermuda. When the spring crop is removed the land should again be plowed about three inches deep and left to summer fallow.

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FIG. 19. Bermuda Grass (*Cynodon dactylon*): A, Portion of a crown showing the rootstock and erect culms, two of the latter bearing the spikes. B, Part of a rootstock producing small culms in the leaf-axils, one of the stems elongated and spikelet-bearing. C, Fruit or grain.

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SAND-BUR.

(*Cenchrus pauciflorus* Bentham.)

English names: (1) Sand-Bur; (2) Bur-grass; (3) Hedgehog-grass; (4) Sandspur; (5) Cockspur-grass; (6) Bear-grass.

DESCRIPTION.

Habit: Annual or perennial grass with both depressed and erect stems; the former widely spreading and freely branching, one foot or more in length and rooting at the nodes; the latter 8 inches to 2 feet in length. *Leaf-sheaths* loosely enfolding the culms, somewhat flattened, smooth and striated, sometimes slightly hairy just below the blade. The small ligule densely hairy. Blades as long or longer than the sheaths (2 to 6 inches long), flat as a rule but often with the halves more or less pressed together. *Flowers* in 1-flowered spikelets which are enclosed in spiny bur-like involucres formed of dwarf culm branches grown together, each globular bur enclosing 1 to 3 spikelets and the several burs (10 to 30) grouped in spikes with spread axes, 2 to 6 inches long, sometimes partially enclosed by the sheath of the uppermost leaf. The burs are easily detached when mature, the spikelets remaining enclosed and the grains germinating from within the bur.

DISTRIBUTION.

The Sand-Bur, now becoming more or less of a nuisance at a few spots in California (Mecca, Oxnard), and from which it may be expected to spread, is not botanically identical with the Common Sand-Bur of the east (*C. tribuloides* L.), but is essentially the same unwelcome invader of both tilled and pasture lands, where its sharp spines are alike objectionable to man and beast.

CONTROL.

Like all the rhizomatous, weedy grasses, Sand-Bur must not be allowed to become well established or the trouble of extermination will be vastly increased. Small patches may be smothered out by laying over them tarred paper, or the spots may be covered with straw or other rubbish and burned. Larger areas must be hoed out or the land cultivated through at least one summer. Stock should not be allowed to graze over areas infested by Sand-Bur when the burs are ripe, since these become attached to the animals and distributed over the range.

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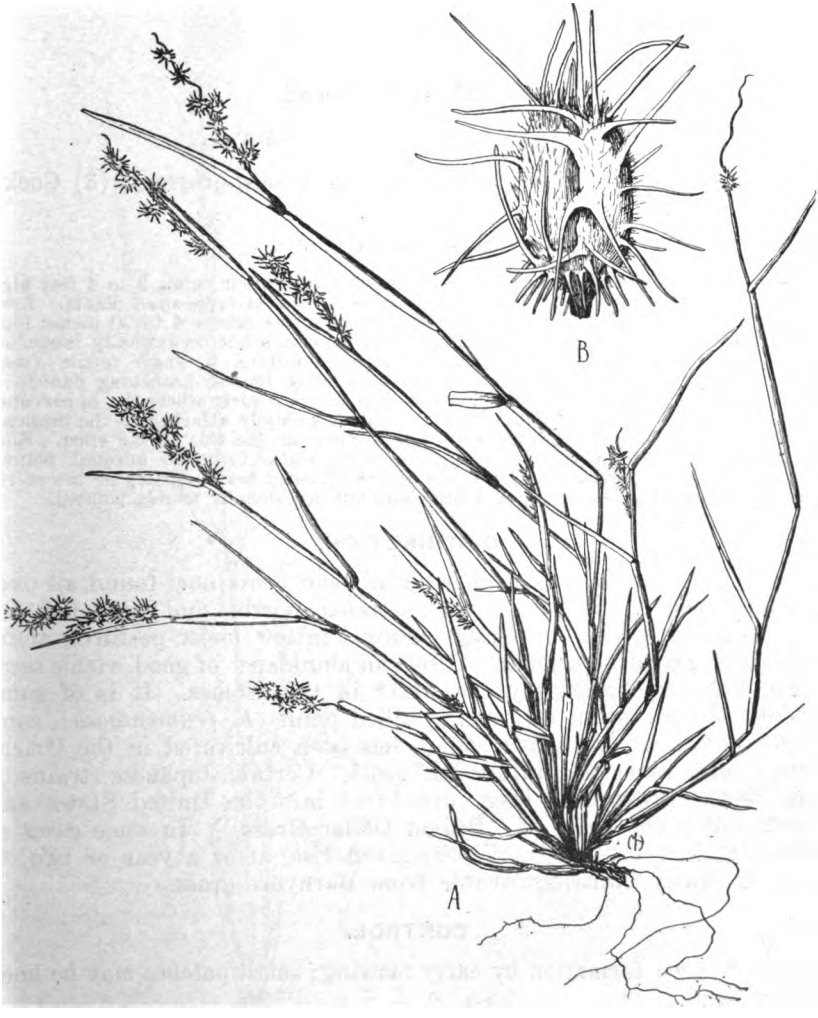

FIG. 20. Sand-Bur (*Cenchrus pauciflorus*): A, Habit of a portion of crown, most of the culms bearing burs. B, Single bur showing the long spines and the dense coat of hairs between the spines.

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BARNYARD-GRASS.

(*Echinochloa crus-galli* Beauv.)

English names: (1) Barnyard-grass; (2) Cockspur-grass; (3) Cocksfoot Panicum.

DESCRIPTION.

Habit: Annual grass of coarse habit of growth with stout culms 2 to 4 feet high, the culms often branching at base and somewhat juicy in large-sized plants. *Leaf-sheaths* smooth, glabrous and more or less flattened; the blades 4 to 20 inches long, ¼ to ¾ inch wide, with prominent midrib, usually smooth but occasionally roughened toward the apex. *Flowers* in spikelets, each containing a single fertile (seed-producing) flower; the spikelets arranged in a large loosely branching panicle of many sessile branches, the lower branches remote from each other, the upper more or less aggregated into a terminal clump. *Spikelets* closely attached to the branches of the panicle and densely crowded in 2 to 4 rows on one side of the stem. Each spikelet green or purple, oval in shape, its empty scales (glumes) unequal, pointed and bristly on their backs; at least one of the included scales (palea of the sterile lemma) usually with an awn ¼ to ½ inch long but occasionally merely pointed.

DISTRIBUTION.

Barnyard-grass is a naturalized European grass now found all over North America, except in the extreme north, and abundant in California. It grows especially vigorous in low moist pastures, along streams or irrigating ditches. It sets an abundance of good, viable seed, which are swept along by the water in the ditches. It is of some interest to note that a very nearly allied plant (*E. frumentacea*), commonly known as Barnyard Millet, has been cultivated in the Orient since remote times as a valued hay grass. Certain Japanese strains of this Asiatic grass have been introduced into the United States and grown under the name of "Billion Dollar Grass." In some cases at least, "Billion Dollar Grass" has given rise, after a year or two, to variants nearly indistinguishable from Barnyard-grass.

CONTROL.

Prevent seed formation by early mowing; small patches may be hoed out by hand.

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FIG. 21. Barnyard-grass (*Echinochloa crus-galli*): A, Single culm with terminal panicle. B, Part of a mature panicle showing the spikelets, x 6.

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JOHNSON-GRASS.

(*Holcus halepensis* L.)

English names: (1) Johnson-grass; (2) Means-grass; (3) False Guinea-grass; (4) Egyptian-grass; (5) Millet-grass.

DESCRIPTION.

Habit: Perennial grass of coarse habit with erect, pithy stems (culms), 2 to 6 feet high and widely spreading underground stems (rhizomes) with scale-like leaves. *Herbage* smooth and glabrous. *Leaf-sheaths* much shorter than the flat blades which vary from 10 to 18 inches long and become an inch wide; midrib of the blade white and prominent. *Flowers* in spikelets which are grouped in threes at the ends of the spreading branches of a panicle 6 to 18 inches long, its branches more or less in whorls. Of the three spikelets in a group only one, the central, is perfect and forms seed. The two lateral spikelets are borne on hairy stalks and contain stamens only. The empty scales (glumes) of the perfect, sessile spikelet oval to pointed in shape, usually tinged with purple and at first hairy with appressed hairs but when the grain ripens, these scales become glabrous and shining; one of the included scales (fertile lemma) usually bearing an awn $\frac{1}{3}$ to $\frac{2}{3}$ inch in length and more or less bent near its middle.

DISTRIBUTION.

Johnson-grass in California is generally regarded as a pernicious weed though originally introduced into the state from the southern states with the expectation that it would prove in California as valuable a forage plant as it has long been in the south. It has become completely naturalized in many districts of the Great Valley and in a few places in southern California. On the Pacific Coast its forage value seems to be distinctly less than in Texas or in the other Gulf States; moreover the tendency to develop a poison, toxic to cattle and horses, appears more pronounced here than elsewhere in the United States. Sudan-grass, lately introduced into California, is a near ally of Johnson-grass and indeed can not be botanically distinguished from *H. halepensis* except for its inability to develop the large, creeping rootstocks so characteristic of Johnson-grass. Sudan-grass is strictly annual and therefore never becomes a weed.

CONTROL.

Although Johnson-grass is an abundant seeder, yet it spreads mainly by its vigorous rootstocks which are abundantly supplied with stored food, each joint sufficing to reproduce the plant. Eradicative measures must ensure the death of these rootstocks. It is claimed that hogs may be used to advantage in clearing an infested field by turning in the animals after the sod is broken by the plow, the juicy, starchy rootstocks being eagerly eaten by swine. The growing of alfalfa upon infested ground that has been plowed is recommended since the Johnson-grass becomes smothered out after the second or third cutting of the alfalfa.

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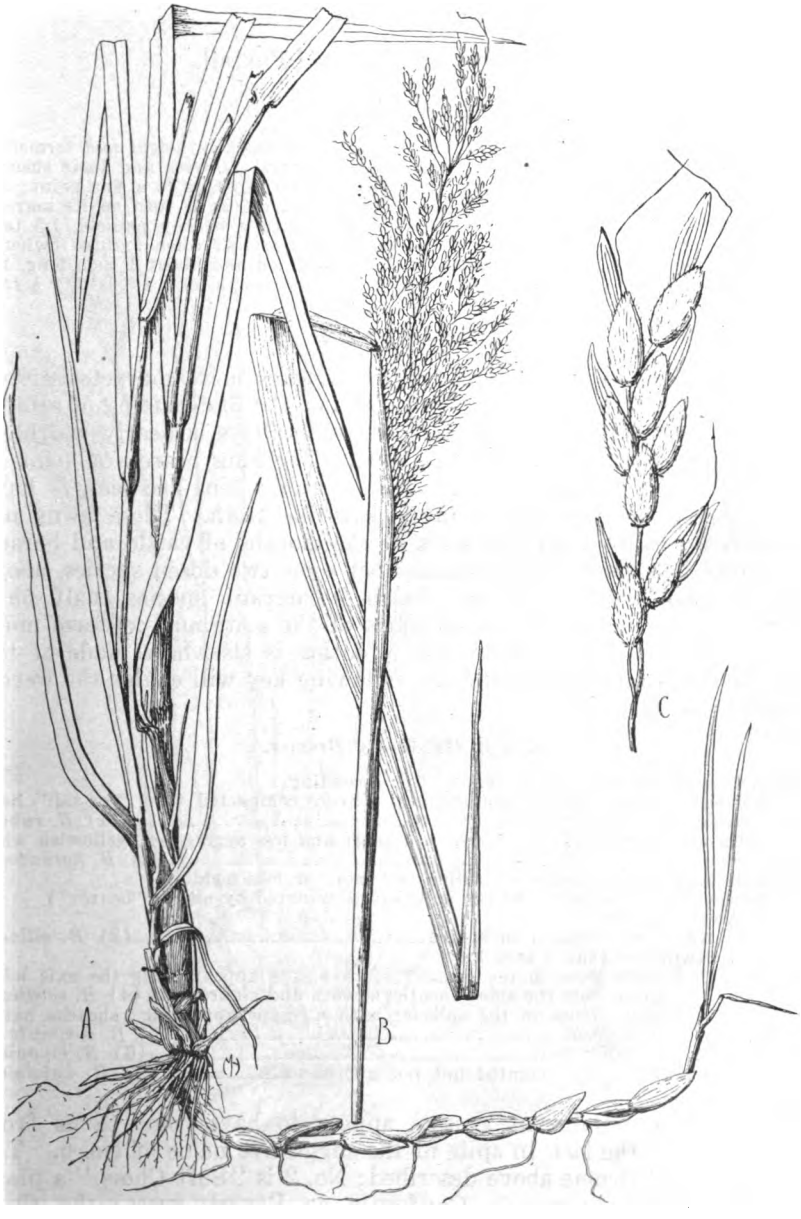

FIG. 22. Johnson-grass (*Holcus halepensis*): A, Habit showing rootstock and culms. B, Panicle with its sheath. C, Group of spikelets, x 6.

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RED BROME.

(*Bromus rubens* L.)

English names: (1) Red Brome; (2) Red Foxtail.

DESCRIPTION.

Habit: Annual grass with erect culms rising ½ to 1.5 feet in height and formed of 3 to 5 joints (internodes), the uppermost slightly hairy. *Leaves* and their sheaths hairy, the blades 1.5 to 4 inches long, very narrow and tapering to a fine point; the papery scale (ligule) between sheath and blade appearing as if torn on its margin. *Flowers* in spikelets which are densely aggregated into a brushy panicle, 1.5 to 3 inches long, at the tops of the culms and becoming purplish when mature (whence the name—Red Brome). Each spikelet 6 to 10-flowered and about 1 inch long, the scales of the flowers (lemmas) tapering to a straight, rough awn ("beard") ½ to ⅝ inch long.

DISTRIBUTION.

The Red Brome is one of the weedy grasses most characteristic of the interior valleys of the state and much of the first cutting of alfalfa grown in the Sacramento and San Joaquin valleys is nearly worthless because of the abundance of this weed. The long beards or awns at the ends of the lemmas when examined with a lens are seen to have their sides roughened with minute, saw-like teeth. These awns not infrequently cause annoying sores in the mouths of cattle and horses. The brome grasses in California number some two dozen species, about half of them native. Of the dozen immigrant species, half have become widely distributed in all parts of the state and conform more or less to the definition of weeds. Mention is elsewhere made of the most famous kind (Chess) and the following key will enable the weedy bromes to be identified:

Key to the Weedy Bromes.

Panicle dense, its short branches erect or ascending.
  Spikelets many, smooth and shining, densely compacted to a "fox-tail" head which becomes purple tinged ---------- (1) *B. rubens*
  Spikelets hairy-pubescent, fewer in number and less aggregated, yellowish when ripe ---------- (2) *B. hordaceous*
Panicle open, the branches spreading and more or less nodding.
  Fertile scales (lemmas) of the spikelets terminated by awns ("beards")
    Awns straight.
      Awns more than 1 inch long ---------- (3) *B. villosus*
      Awns less than 1 inch long.
        Florets loose in the spikelet so that gaps appear along the axis when seen from the side; sheaths smooth and glabrous ---- (4) *B. secalinus*
        Florets dense in the spikelet with no gaps appearing; sheaths hairy-pubescent ---------- (5) *B. commutatus*
    Awns twisted or bent ---------- (6) *B. japonicus*
  Fertile scales merely pointed but not awned ---------- (7) *B. unioloides*

All of these immigrant grasses appear to have come to us from Europe, except the last, in spite of the suggestive name of No. 6. The first is the Red Brome above described; No. 2 is "Soft Chess," a plant not uncommonly known in California as Poverty-grass; the third species with us is often called "Broncho-grass"; *B. secalinus* is the notorious Chess of the wheat farmer and is elsewhere described and figured; the other species listed in the key are of lesser importance,

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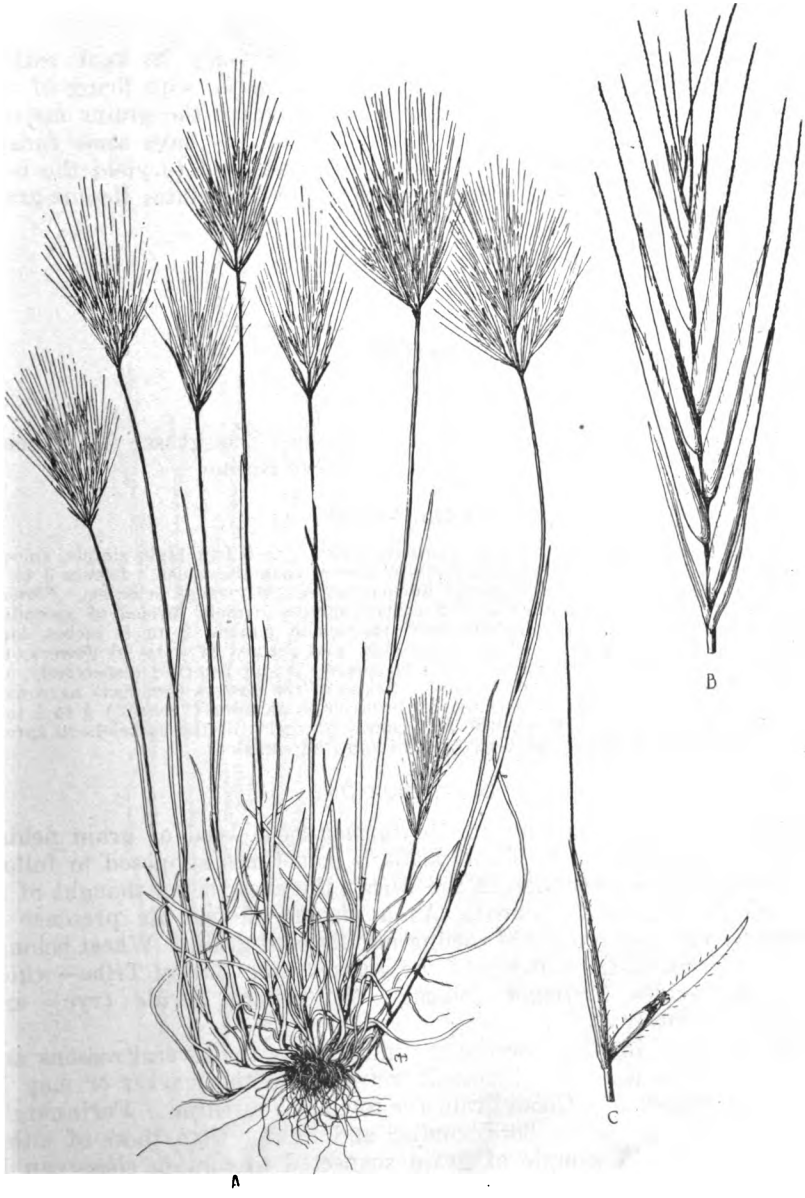

FIG. 23. Red Brome (*Bromus rubens*): A, Clump of spikelet-bearing culms. B, Single spikelets, x 4, showing glumes below and flowers above. C, Single flores, x 4, with lemma and palea separated.

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though the last is becoming conspicuous in places under the name of Rescue-grass.

CONTROL.

All of these brome-grasses are annuals and may be kept within bounds by the same procedures: Mowing roadsides, with firing of the dry herbage, or hoeing out smaller colonies before the grains mature will prevent too rapid spread. The young plants have some forage value; indeed Chess in Modoc County is considered to yield the best wild hay growing on the ranges. In the southern states Rescue-grass is grown as a hay-grass.

CHESS.

(*Bromus secalinus* L.)

English names: (1) Chess; (2) Cheat; (3) Cheat-grass; (4) Wheat-Thief; (5) Williard's Brome-grass; (6) Rye-Brome.

DESCRIPTION.

Habit: Annual grass with stems (culms) erect, 1 to 3 feet high, simple, smooth and glabrous. *Leaf sheaths* smooth, usually shorter than the nodes. *Leaves* 3 to 10 inches long, ⅛ inch wide, usually smooth but not infrequently rough or hairy. *Flowers* in spikelets which are grouped into a rather narrow panicle formed of ascending branches bearing 2 to 3 spikelets each, the whole panicle 2 to 8 inches long. Individual spikelets ½ to ¾ inch long, swollen, and formed of 6 to 10 flowers, the empty scales (glumes) at the base of each spikelet 3 and 7-nerved respectively, the lower pointed at the tip, the upper blunt. Scales of the flowers (lemmas) narrowing to the tip and more or less rough above, produced as an awn ("beard") ½ to ¾ inch long. When the grains are mature they cause the scales of the spikelets to spread apart sufficiently to permit light to pass through the spikelet.

DISTRIBUTION.

Chess is all too familiar to the farmer as a weed of grain fields; indeed its abundance in wheat fields is sometimes supposed to follow as a result of deterioration in the wheat, the chess being thought of as a kind of degenerate wheat. As a matter of fact its presence is generally the consequence of sowing impure seed grain. Wheat belongs to an entirely distinct group of the grasses—the Barley Tribe—which includes besides *Triticum* (wheat), the genera *Secale* (rye) and *Hordeum* (barley).

Chess grains in wheat or rye are undesirable for several reasons and grain so contaminated brings a lower price in the market or may be rejected altogether. Clean grain for sowing is essential. Fortunately, the grains of chess are both smaller and lighter than those of either wheat or rye. A sample of grain suspected to contain chess can be easily determined by stirring into a pail of water; the chess comes to the top and its proportion can be estimated.

CONTROL.

(See methods prescribed for Red Brome-grass.)

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FIG. 24. Chess (*Bromus secalinus*): A, Habit of chess, x ½. B, Spikelet of *Bromus villosus* (Broncho-grass), x 3. C, Spikelet of chess, x 3.

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NUT-GRASS.

(*Cyperus rotundus* L.)

English names: (1) Nut-grass; (2) Florida Nut-grass; (3) Nut Sedge; (4) Coco Sedge; (5) Coco-grass.

DESCRIPTION.

Habit: Perennial by means of scaly underground stems which produce small tubers. Aerial stems erect, slender, 3-angled and grooved, 6 to 20 inches high and leafless above the base. *Leaves* grass-like with closed sheaths, their blades 6 to 9 inches long with the prominent midrib projecting on the underside; the leaves appearing before the flowering stems develop. *Flowers* small and crowded into spikelets ½ to ¾ inch long; spikelets chestnut-brown in color, grouped at the top of the stem in an umbel with unequal rays. Involucre of the umbel of 2 to 3 narrow leaves (bracts), 2 to 4 inches long. Single flower without calyx or corolla but enclosed by a brown keeled scale (bract of the spikelet) and consisting of 3 stamens and one pistil. Ovary becoming a 3-angled achene and produced upward as an elongated style with 3 terminal threadlike stigmas, the latter projecting from between the scales of the spikelet.

DISTRIBUTION.

Nut-grass is a recent addition to the too rapidly lengthening list of California weeds but it appears to be now well established in several places and everywhere proves itself a difficult invader to keep at bay. The plant seeds abundantly and the achenes (seed-like fruits) seem to be well equipped to withstand hard times so that ground which has become seeded by the pest will produce new plants for at least two years even if during that time no growth has been permitted to set flowers and fruit. Spreading is also effected by the rhizomes (underground stems), each tuber of which contains enough stored food material to send up a stalk bearing leaves and flowers.

Closely related and appearing much the same as the plant just described is another so-called "nut-grass," the Chufa of the South (*Cyperus esculentus* L.). This is now fairly abundant in low, moist land in southern California, from Los Angeles to Riverside, and is doubtless present in other parts of the state but as yet unrecognized. Chufa may be distinguished from *C. rotundus* by the color of the spikelets which are a light straw color. Chufa has considerable value as hog forage and is cultivated to some extent for this purpose in the Gulf states.

CONTROL.

Stop the invasion of new land by preventing fruit formation; cultivate infested areas to exhaust the subterranean tubers from which new stems arise.

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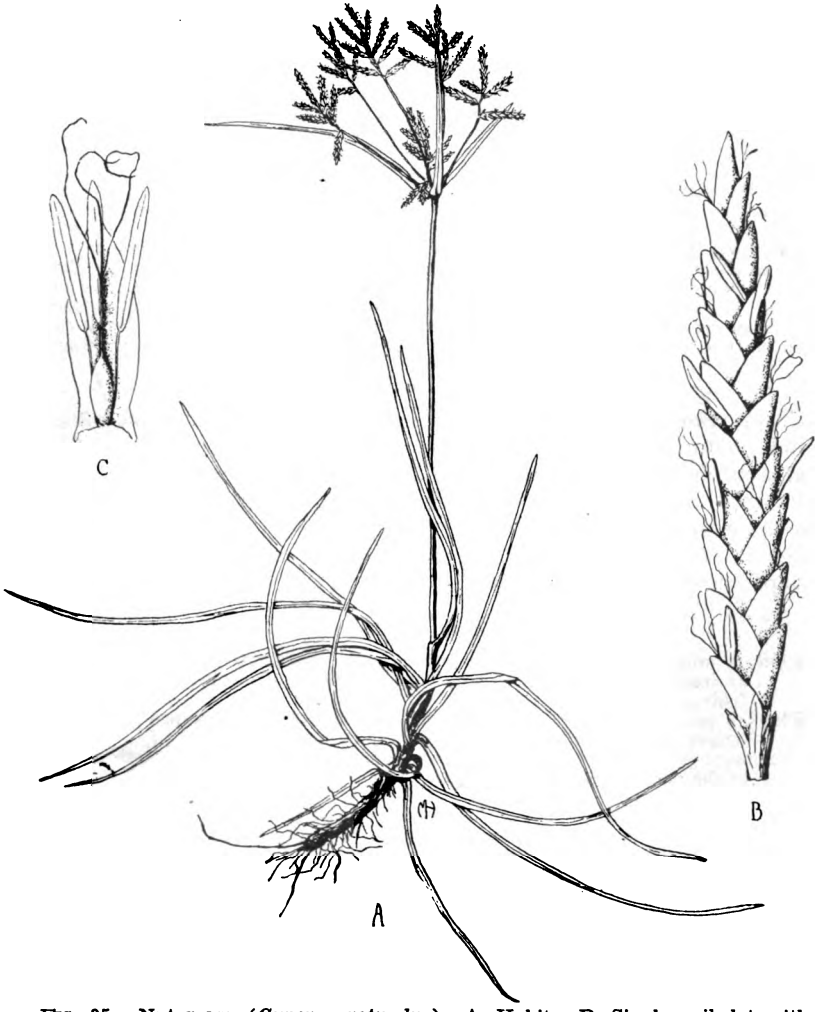

FIG. 25. Nut-grass (*Cyperus rotundus*): A, Habit. B, Single spikelet with stamens and stigmas of some of the flowers protruding, x 10. C, Single flower removed from the spikelet; the essential organs (stamens and pistil) are seen in front of the scale, x 15.

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SHEEP SORREL.

(*Rumex acetosella* L.)

English names: (1) Sheep Sorrel; (2) Field Sorrel; (3) Horse Sorrel; (4) Sour Grass.

DESCRIPTION.

Habit: Perennial weed with one to many wiry stems, simple as a rule but occasionally branching, rising ½ to 2 feet high from slender running rootstocks; the latter branched and fibrous with many small tufted rootlets at intervals. *Leaves* mostly with one large pointed terminal lobe, widest above the middle, and a pair of small lobes at its base at right angles to the large lobe (halberd-shaped leaf); the uppermost leaves reduced, the lateral lobes sometimes wanting and then the leaf outline linear; all the lobed leaves on slender leaf-stalks as long or longer than the blades, each leaf-stalk with a pair of silvery scales (stipules) at its base encircling the stem and constituting the ocrea. *Herbage* smooth and sour, more or less dotted. *Flowers* unisexual, the staminate and pistillate flowers on different plants (dioecious), grouped in terminal, naked, panicled racemes, each branch (raceme) bearing numerous flowers arranged in whorls more or less remote from each other. Flowers without a corolla, the 6 calyx lobes (3 outer reflexed, 3 inner erect and persistent) pointed, borne on short flower-stalks about as long as the flowers or a little longer. Staminate flowers colored greenish-yellow by the projecting anthers and larger than the pistillate flowers, which have reddish sepals and bright red stigmas. *Fruit* an achene, triangular in cross-section, its surface granular, resembling a small grain of buckwheat; when mature, projecting beyond the tips of the three inner persistent fruiting sepals.

DISTRIBUTION.

Sheep Sorrel belongs to the Buckwheat Family (*Polygonaceae*), which includes besides Buckwheat and Rhubarb, a number of plants that assume the role of weeds in our fields and gardens, among them the docks, which may be mentioned here since they are all species of the same genus as Sheep Sorrel. In California there are some half-dozen dock weeds with characters distinct from each other and from Sheep Sorrel, as shown by the following key:

Key to the Sorrels.

Flowers unisexual, staminate and pistillate on distinct plants (plants dioecious); at least some of the leaves halberd-shaped; fruiting sepals shorter than the fruit and exposing it ..... (1) *R. acetosella*

Flowers perfect, at least some of them; no leaves halberd-shaped; fruiting sepals longer than the achene and completely covering it.

Annual plant; inner whorl of sepals bearing 2 to 3 awn-like teeth on each side of the pointed tip ..... (2) *R. persicarioides*

Perennials.

Inner fruiting sepals bearing teeth or bristles on their free margins.

Flower-stalks very slender (filiform), longer than the herbaceous fruiting sepals ..... (3) *R. obtusifolius*

Flower-stalks thick, shorter than the thick and firm fruiting sepals ..... (4) *R. pulcher*

Inner fruiting sepals with their margins even (entire).

Leaf surface flat, not crinkly; foliage very light green or whitish ..... (5) *R. salicifolius*

Leaf surface crinkled; foliage deep green or bluish-green.

"Grain" (wart) on the fruiting sepals small and surrounded by the surface of the sepals as a broad wing ..... (6) *R. crispus*

Grain large, nearly covering its sepal and so nearly wingless ..... (7) *R. conglomeratus*

All of these docks are naturalized European weeds except Nos. 2 and 5, the former widely distributed in the cooler parts of North America, the latter peculiar to the west. Of the introduced species, *R. crispus* (Curly Dock) is the most common, found everywhere in low waste lands, with Fiddle Dock (*R. pulcher*) nearly as prevalent. The third species, known as Bitter Dock, was early introduced into the low lands

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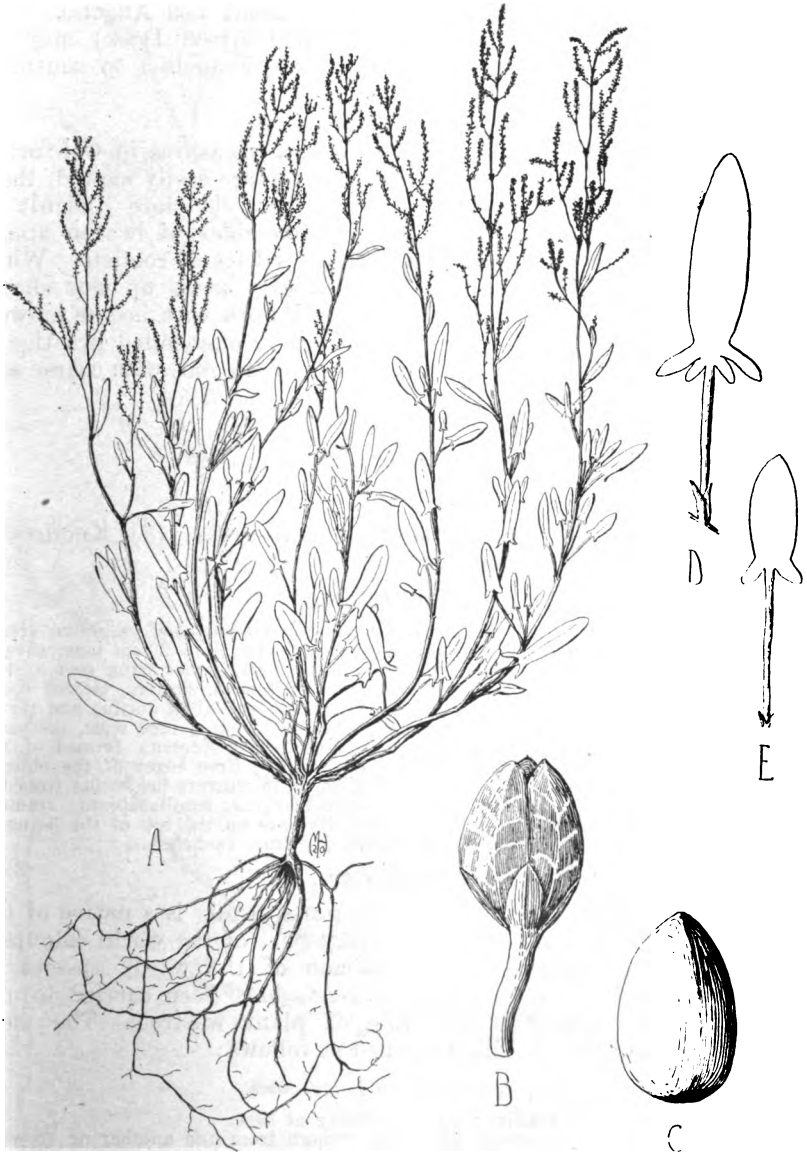

FIG. 26. Sheep Sorrel (*Rumex acetosella*): A, Habit of small-size plant, x 1. B, Fruiting calyx showing the three small, spreading sepals below the three inner, erect, fruiting sepals; the tip of the achene is seen inside the sepals, x 48. C, Fruit, x 48. D, Halberd-shaped leaf with two pairs of lateral basal lobes. E, Halberd-shaped with a single pair of basal lobes.

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about San Francisco Bay and is now found throughout central California in marshy places. Golden Dock (*R. persicarioides*) is widely distributed in the state and very common about Los Angeles. The remaining species (No. 7 of the key, called Green Dock) may be expected in any marshy meadow from San Francisco to southern California.

CONTROL.

The docks are usually not cause for special measures in California to keep them in check; when too abundant they are easily mowed, their succulent stems quickly wilting. Sheep Sorrel is more difficult to combat, it seeds abundantly and the cord-like roots, if broken apart, may give rise to new plants at each of the fascicles of rootlets. When simply mowed, the dense, woody crown quickly sends up new shoots and may repeat this several times in spite of work with hoe or mower. When this weed is prevalent in dooryards, a recommended practice is to hoe off the crown and sprinkle the cut top of the root with coarse salt (stock or ice-cream salt).

WIRE-GRASS.

(*Polygonum aviculare* L.)

English names: (1) Wire-grass; (2) Yard-grass; (3) Knotgrass; (4) Doorweed; (5) Prostrate Knotweed.

DESCRIPTION.

Habit: Annual or perennial with slender, simple, or branched whip-like stems, prostrate or with ascending tips and bluish-green in color, ½ to 2 feet long, several spreading from the summit of freely branching and deeply penetrating root system composed of a major central root and numerous yellowish, fibrous, lateral roots. *Leaves* deep bottle-green in color, simple, entire, narrowly oval in outline and terminating in a scarcely acute tip, ½ to 1.5 inches long and about ⅜ inch wide, the veins obscure; borne on short leaf-stalks jointed to the sheath (ocrea) formed of the papery stipules and encircling the joints of the stems. Free edges of the oblique ocrea frayed. *Flowers* small, short stalked and borne in clusters projecting from the ocrea; calyx 5-parted, its lobes green with pinkish margins; corolla absent; stamens 8 or rarely 5; the short style 3-divided to near its base on the top of the 3-angled ovary; ovary ripening to a dull-green one-seeded dry fruit (achene).

DISTRIBUTION.

Wire-grass (which, of course, is not a grass at all) is a native of the Old World that has been carried to every part of the world colonized by Europeans; though the most common of the weedy species of *Polygonum*, other plants of the same genus have been carried to our shores and now appear in the role of plant wastrels. The most important of these may be distinguished as follows:

Key to the Weedy Polygonums.

Plants not twining nor trailing; leaves tapering at base.
  Flowers in axillary clusters, which are remote from one another or crowded into a terminal spicate raceme, bracts leaf-like; bracts and leaves jointed to their short stalks----------(1) *P. aviculare*
  Flowers in dense spikes, the bracts small and scarious (like tissue paper).
    Perennial of low moist or marshy land----------(2) *P. acre*
    Annuals.
      Flowers white or pale rose color; leaf-sheaths (ocreae) with their free edges entire or nearly so (not ciliate)----------(3) *P. lapathifolium*
      Flowers pink or purple; leaf-sheaths with free edges jagged (bristle-ciliate) ----------(4) *P. persicaria*
Plants twining or trailing; leaves heart-shaped at base (cordate)----------
----------(5) *P. convolvulus*

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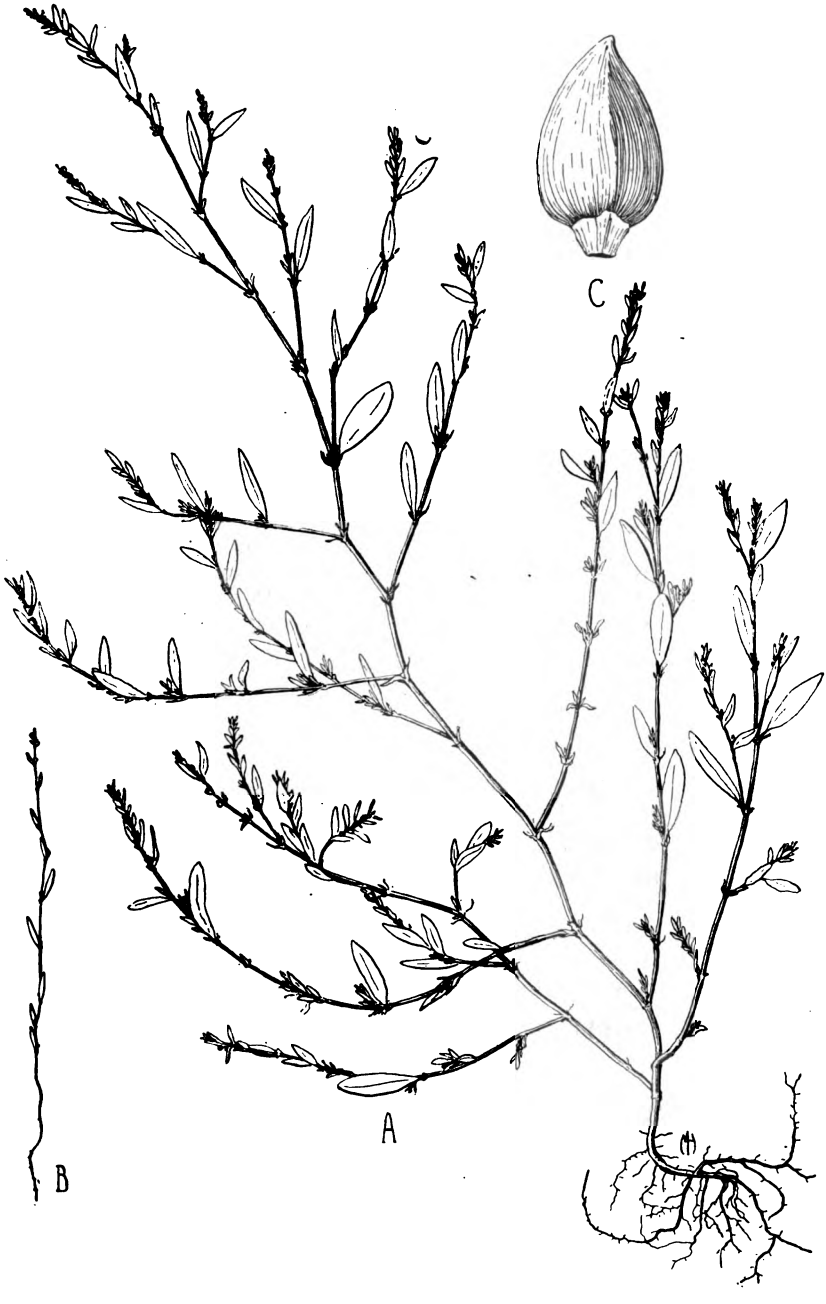

FIG. 27. Wire-grass (*Polygonum aviculare*): A, Medium-sized plant of wire-grass, x 1; the living plant lay flat upon the ground, the turn in the root shown in the figure caused in this way. B, Dwarf of dry, hard soil, x 1, bearing one or two flowers. C, Achene, x 24.

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The second species, commonly known as Dotted Smartweed because of the glandular dots upon the sepals, is a native of the warmer parts of America, now found in many places in the United States; it grows luxuriantly in the Sacramento Valley where it is valued as a bee plant. Common Knotweed or Willow-weed (*P. lapathifolium*) is a stout branching annual with enlarged stem joints, found generally in low, wet swales or along streams. Lady's Thumb (*P. persicaria*) resembles Common Knotweed and is found in similar situations, especially abundant in central California; the common name refers to the dark brownish blotch usually seen upon the upper surface of the leaves and ascribed to the thumb-print of the Virgin Mary. Black Bindweed (*P. convolvulus*) differs from the other species by its sprawling, vine-like habit; distributed in California from Sisson to Pasadena, growing in cultivated fields, sometimes so rankly as to smother the crops.

CONTROL.

Wire-grass as found in dooryards, about buildings or on vavant lots should be kept under control by hoeing off the crown before the seeds ripen. Fortunately it does not invade tilled land to any extent nor appear in pastures. Lady's Thumb is a troublesome weed in some parts of the east, being widely scattered as an impurity in Red Clover seed; in California as yet it seems to have caused little annoyance. The last mentioned species is possibly the most objectionable of the list even if to date in California it has not demonstrated on a large scale its power to harm; possibly it has been mistaken for the Orchard Morning-glory or Field Bindweed, which it resembles slightly in leaf outline and is found growing in similar places. However these two "bindweeds" have nothing in common except similarity of common name and character of weeds. Black Bindweed is readily distinguished by the small, greenish flowers, each producing a single, small, shining, black, seed-like fruit (achene). These fruits have about the same food value as true Buckwheat (belonging to the allied genus *Fagopyrum*) and the plant has been grown for forage.

WINGED PIGWEED.

(*Cycloloma atriplicifolium* [Sprengel] Coulter.)

English names: (1) Winged Pigweed; (2) Tumbleweed.

DESCRIPTION.

Habit: Annual, much-branched herb, ½ to 2 feet high, the rigid, spreading branches more or less angular and grooved, light gray-green at first but becoming purplish, smooth or sparsely hairy on young plants. *Leaves* short-stalked, narrow, 1 to 3 inches long, alternate on the stems, their margins irregularly and shallowly toothed, the teeth acutely pointed. *Flowers* either perfect (i.e., with 5 stamens and 2 to 3 styles) or with styles only (pistillate), grouped near the ends of the slender branches in interrupted spikes. Each flower without a corolla; the calyx composed of 5 keeled sepals converging over the ripening fruit and nearly enclosing it. *Fruit* dry, swollen ovary loosely enclosing the single, flattened seed, and margined by a broad, circular wing developed by outgrowths from the base of each sepal.

DISTRIBUTION.

Introduced weed, native along the western border of the Great Plains region from Manitoba to Texas and ranging westward to Arizona, now

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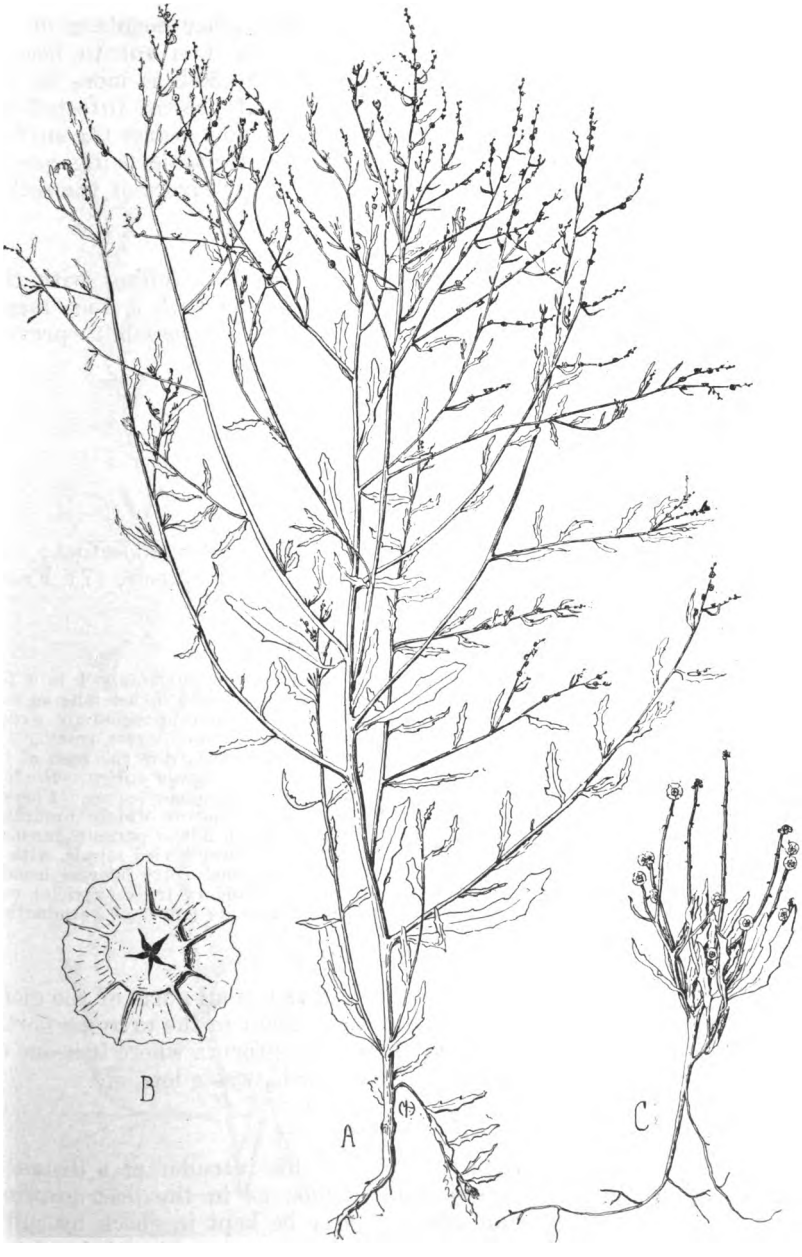

FIG. 28. Winged Pigweed (*Cycloloma atriplicifolium*): A, Habit of good-sized plant bearing flowers and immature fruit. B, Plant dwarfed by local conditions but nevertheless bearing developed fruit and viable seed. C, Fruiting calyx viewed from above, showing the 5-rayed slit, beneath which is the ovary, and the broad, membranous wing.

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becoming abundant at two or three localities in Southern California, notably about Ontario and Rialto. Like many other members of the Goosefoot Family of plants, the Winged Pigweed is apt to become especially abundant on low lying ground where alkali is more or less abundant. In Southern California, the areas at present infested are in districts where the ground-water has been brought nearer the surface because of excess irrigation, the rise of the water-table being accompanied by an increase of soluble salts in the upper layers of the soil.

CONTROL.

In small patches, the most practicable method of coping with this objectionable immigrant is to grub out the colony with a hoe; larger areas may require intensive cultivation through one season to prevent seed formation.

LAMB'S-QUARTERS.

(*Chenopodium album* L.)

English names: (1) Lamb's-quarters; (2) White Goosefoot; (3) Pigweed; (4) Mealweed; (5) Fat Hen; (6) Wild Spinach; (7) Frostblite.

DESCRIPTION.

Habit: Annual herb with erect, pale green, slender stems, commonly 1 to 4 feet tall but not rarely twice as high, branching above. *Leaves* ½ to 4 inches long on leaf-stalks ½ to 1 inch in length; form of the blade variable, not uncommonly wedge-shaped from a broad base, especially on the lower leaves; upper leaves smaller and narrower; all the leaves bluntly pointed, prominently 3-nerved from the base of the blade, their margins wavy, toothed, or lobed, or the upper leaves entire. *Herbage* more or less white-mealy, especially the under sides of the younger leaves. *Flowers* bractless, densely clustered in spikes that compose a narrow or widely branching terminal panicle, or solitary in the axils of the leaves. Each flower perfect, greenish, closely attached to its stem; composed of 5 or, less often, fewer keeled sepals, with as many stamens opposite to the sepals, and a superior, flattened ovary bearing usually 2 slender, short, ascending styles and developing into a bladdery fruit (utricle) containing a single, black, shining, flat seed that long retains its power of germination.

DISTRIBUTION.

Native of the Old World but now naturalized in all parts of the globe and common in all parts of North America except in the extreme north. Common everywhere in the settled parts of California where it is one of the most familiar weeds of neglected backyards, waste lots, etc.

CONTROL.

Persistent attention is required to keep this intruder at a distance. Where it is a nuisance in cultivated fields, as in the beet growing sections or in fields of young grain, it may be kept in check by cultivating with the ordinary farm implements, harrows, cultivators; in gardens and door-yards, hoeing or hand-pulling is the only sure means of combating the pest. It is not sufficient to cut off the top of the crown only, since the plant readily sends up two or three secondary stems to replace the one cut.

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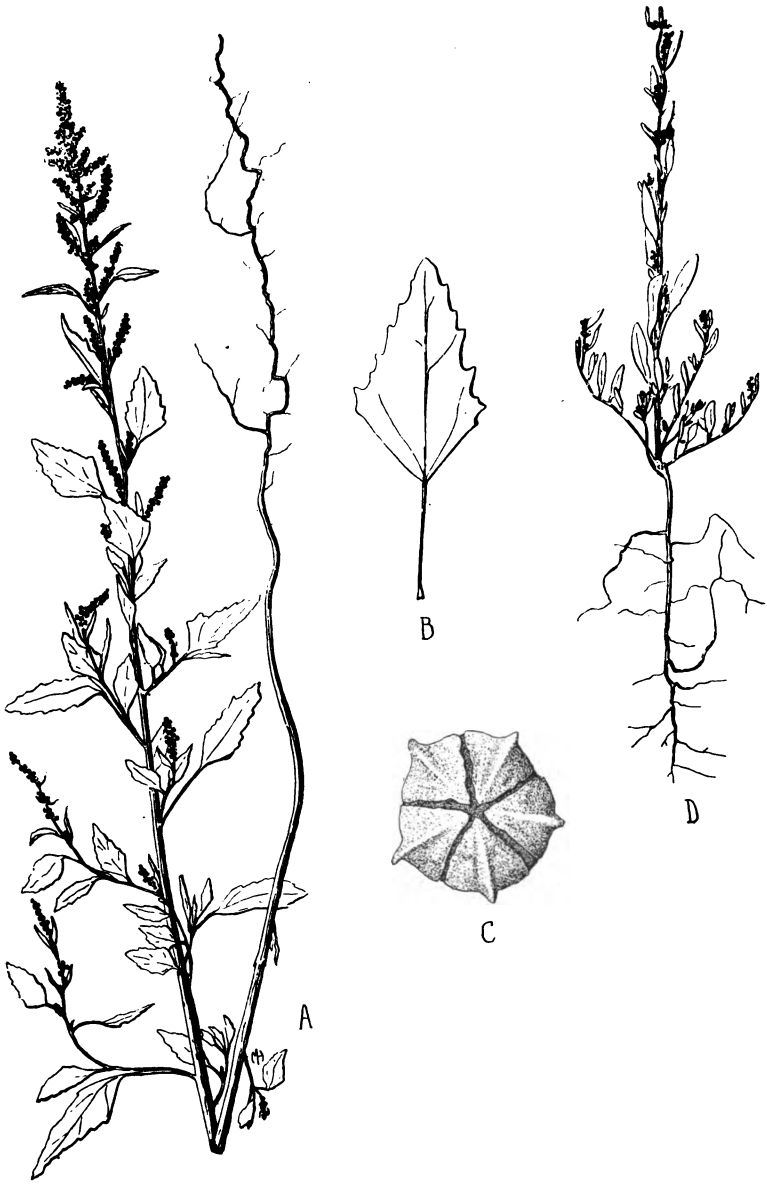

FIG. 29. Lamb's-quarters (*Chenopodium album*): A, Habit of typical plant. B, Leaf outline. C, Fruit enclosed by the five-keeled sepals. D, Plant which has had its primary stem removed and replaced by several laterals, one of which has outstripped the others.

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RUSSIAN THISTLE.

(*Salsola kali* L. var. *tenuifolia* Meyer.)

English names: (1) Russian Thistle; (2) Wind Witch; (3) Tumbling Thistle; (4) Russian Tumble-weed.

DESCRIPTION.

Habit: Pernicious, bushy annual with many slender, erect or ascending stems 10 inches to 3 feet high, smooth and striate, occasionally hairy; at first tender and juicy but later becoming rigid and spinescent. *Leaves* on the young plant very narrow, thread-like, pointed, an inch or more long, each with a short shoot in its axil. This early foliage drops off as the stems become woody, the foliage of the mature plant consisting of short (½ inch or less), awl-like spines (bracts) attached to the stems by broadened bases, each spine with a pair of small spiny bractlets at its base. The mature herbage more or less reddish. *Flowers* solitary, perfect, in the axils of the mature foliage (bracts) and borne on the stems from near their base. Each flower without a corolla but having a calyx of 5 divisions (sepals), their tips converging over the center of the flower; each sepal bearing a horizontal veiny wing on its back, the five wings meeting to form a broad, papery margin to the flower, usually light straw-colored but not rarely pink, its edges more or less frayed. Stamens 5. *Ovary* covered by the ascending tips of the sepals, only its styles protruding. Ovary becoming dry, inflated at maturity and forming in fruit a flattened utricle, enclosing a horizontal seed.

DISTRIBUTION.

Russian Thistle became notorious in the United States as a pest in the grainfields of Minnesota and the Dakotas. It appears to have been introduced about fifty years ago as an impurity in flax seed imported from Russia. In ten years it had spread over much of the northern Great Plains and is now found in all parts of the west. The date of its introduction into California is not certainly known though it was collected in the Antelope Valley, Los Angeles County, some thirty years ago. It is now distributed over the southern half of the state, each year increasing the area of occupation. Russian Thistle is a "tumble-weed" in habit, although quite distinct botanically from Common Tumble-weed (*Amaranthus graecizans*) and its spread is chiefly effected by the wind driving along the old, rigid, dry plants, the seeds being strewn along the course. The plant is immensely productive of seed; it has been estimated that a single medium-sized plant will produce 20,000 to 30,000 seeds. It is this great reproductive power which makes its eradication so difficult.

CONTROL.

Mow the plants as near the ground as possible before it sets seed; fortunately the plant does not send up new shoots, the root soon dying after the top is cut off. Land badly infested as the result of growing grain several years with Russian Thistle as an associate, is best put to some tilled crop like corn or beans for a year or two. It is stated by Prof. W. W. Robbins, of Colorado, that Russian Thistle can not stand much moisture and that it is feasible to rid alfalfa of its presence by irrigating when the "thistles" are about two or three inches high.

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FIG. 30. Russian Thistle (*Salsola kali* var. *tenuifolia*): A, Small-sized plant, x 1. B, Seedling just beginning to develop the spiny bracts characteristic of the mature "thistle," x 1. C, Flower, x 16; note the surrounding spiny bracts.

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PIGWEED.

(*Amaranthus retroflexus* L.)

English names: (1) Pigweed; (2) Rough Pigweed; (3) Chinaman's Greens; (4) Green Amaranth.

DESCRIPTION.

Habit: Coarse, annual herb with stout, branching stem, 1 to 4 feet in height, the lateral branches spreading and ascending, shorter than the central stalk; form of the whole plant more or less rounded. *Leaves* oval, the lower blunt, the upper usually pointed, on leaf-stalks about half as long as the blade; veins prominent; undersides of the leaves and the stems more or less reddish. *Flowers* green or yellowish-green, crowded on spikes in the angles between stems and leaf-stalks (leaf axils) or at the ends of the branches, each spike 1 to 1.5 inches long. Each flower enclosed by rigid, prickly bracts, without petals, and consisting of 5 stamens surrounding a solitary egg-shaped ovary having 2 to 3 stigmas at its summit; at maturity the ovary has ripened to a bladder-like fruit (utricle), which splits around at the middle, exposing the single, black, shining seed; seed somewhat flattened on each face.

DISTRIBUTION.

Pigweed belongs to a family of the flowering plants—the Amaranths—which includes a number of hardy growths that seem to thrive best where conditions appear to be almost at their worst; not but what, if given the chance, they can quickly demonstrate their vigor on good soil. A few species of *Amaranthus* are indigenous to the state, but all the plants distinguished in the following key are immigrants of more or less weedy habit:

Key to the Weedy Amaranths.

Utricle at maturity more or less soft walled or fleshy and not splitting open; prostrate, spreading plant ..... (1) *A. deflexus*

Utricle with dry or papery wall, splitting at maturity, the top coming off like a lid.

Flowers in small axillary clusters.

Plant prostrate; the utricle smooth or slightly wrinkled ..... (2) *A. blitoides*

Plant with erect or ascending branches becoming a "tumbleweed"; utricle very wrinkled ..... (3) *A. graecizans*

Flowers, at least the upper, in dense spikes at the tops of the stems.

Plants spiny with 2 sharp spines, ½ to 1 inch long, in the leaf axils ..... (4) *A. spinosus*

Plants without axillary spines.

Spikes thick, erect; stems harsh and herbage dull green ..... (5) *A. retroflexus*

Spikes slender, more or less nodding at the tip; stems smooth and herbage deep green ..... (6) *A. hybridus*

Of these half-dozen species, No. 4 is not yet, to our knowledge, reported from the state and is here considered only because of the probability that it will, sooner or later, turn up and earn the same ill-fame it has in the southern states. Nos. 3 and 5 are considered in the text. No. 2 is a native of the Great Basin region from Washington to Colorado and Mexico and is reported as established at several places along the Californian coast. *A. hybridus* is believed to have come to us from tropical America, while the Low Amaranth (*A. deflexus*) is native to the Old World.

CONTROL.

Control methods for all the species center upon the need of preventing the plants maturing, for, when the seeds are ripe, the stems generally become easily broken just above the ground and the plants are spread hither and thither by the wind ("tumbleweeds") or dragged from place to place by farm implements, stock, etc., scattering their fruits or seeds as they go.

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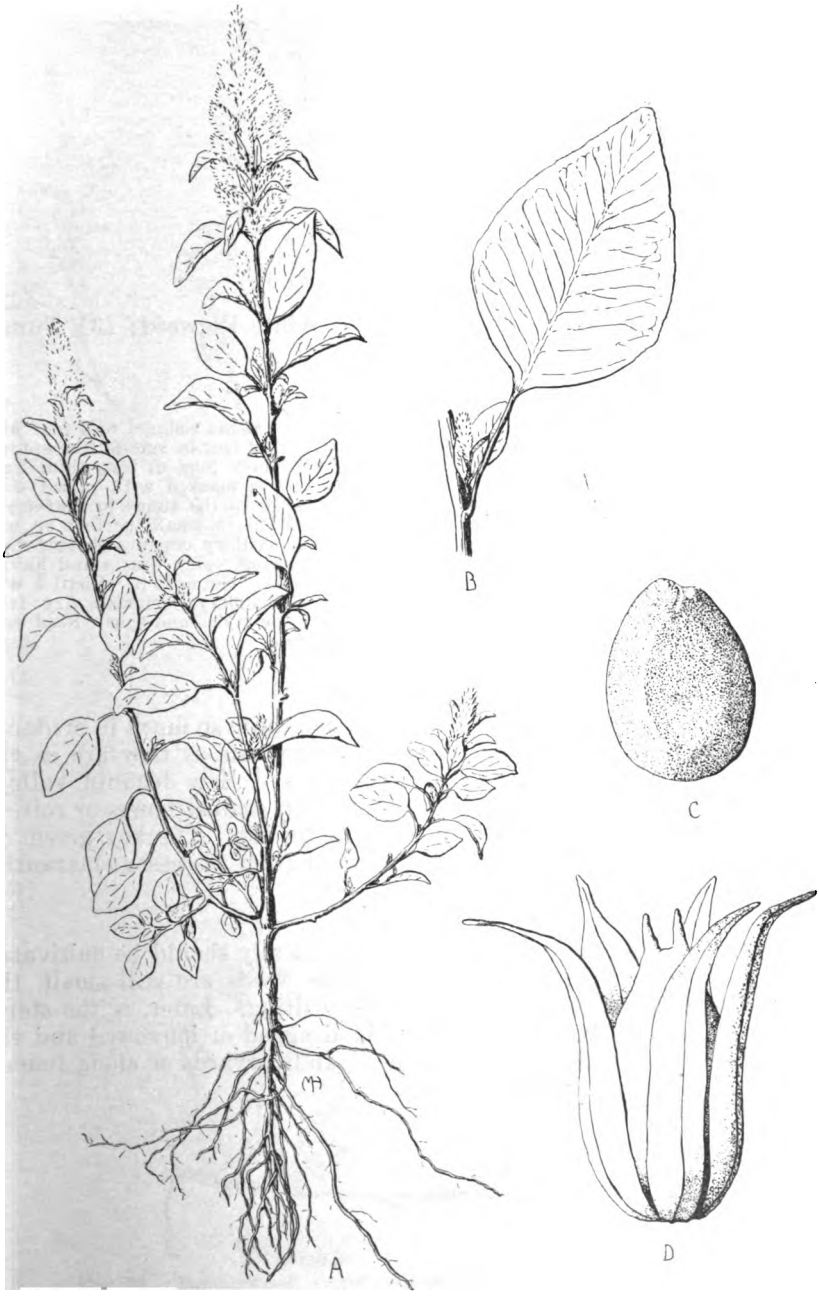

FIG. 31. Pigweed (*Amaranthus retroflexus*): A, Habit of a small plant of *A. retroflexus*. B, Leaf with small spikes in the axil. C, Seed, enlarged. D, Fruit surrounded by the 5 sepals.

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TUMBLEWEED.

(*Amaranthus graecizans* L.)

English names: (1) Tumbleweed; (2) White Pigweed; (3) Tumbling Pigweed.

DESCRIPTION.

Habit: Coarse annual with shallow, spreading roots; stems rising 1 to 4 feet high with rigid, lateral branches spreading from the base, 1 to 2 feet in length; the smooth herbage light green or whitish. *Leaves* small, about 1 inch long or less, thin, light green above but often reddish beneath and more or less marked with raised dots, broadening upward to a blunt, rounded tip and attached to the stems by leaf-stalks about as long as the blades. Venation prominent. *Flowers* small, perfect or unisexual, densely crowded in erect or slightly spreading axillary clusters shorter than the leaves. Each flower surrounded by 3 slender, tapering, spiny bracts and having a calyx of 3 sepals much shorter than the enclosing bracts. Stamens 3. Pistil 1 with 3 short styles and an ovary becoming a one-seeded, bladdery, wrinkled, dry fruit (utricle), which splits around the middle line between the styles and base. *Seed* very small, black, smooth and shining. Mid-summer and fall.

DISTRIBUTION.

Tumbleweeds in California are perhaps not quite so much in evidence in their characteristic role of wind-swept vagrants as they are in the Mississippi Valley, yet in the Sacramento and San Joaquin valleys one often sees their rigid, dry shapes heaped up against fences or rolling along the roads, scattering their seeds in transit. The key given on page x will serve to distinguish Tumbleweed from the other amaranths.

CONTROL.

Farm land growing tumbleweed too prolifically should be cultivated at least once during the summer while the weeds are still small, the plants being easily uprooted and quickly wilting. Later, if the stems have begun to stiffen, the field should be dragged or harrowed and the herbage burned before the seeds mature. In dooryards or along fences, hand work is about the only recourse.

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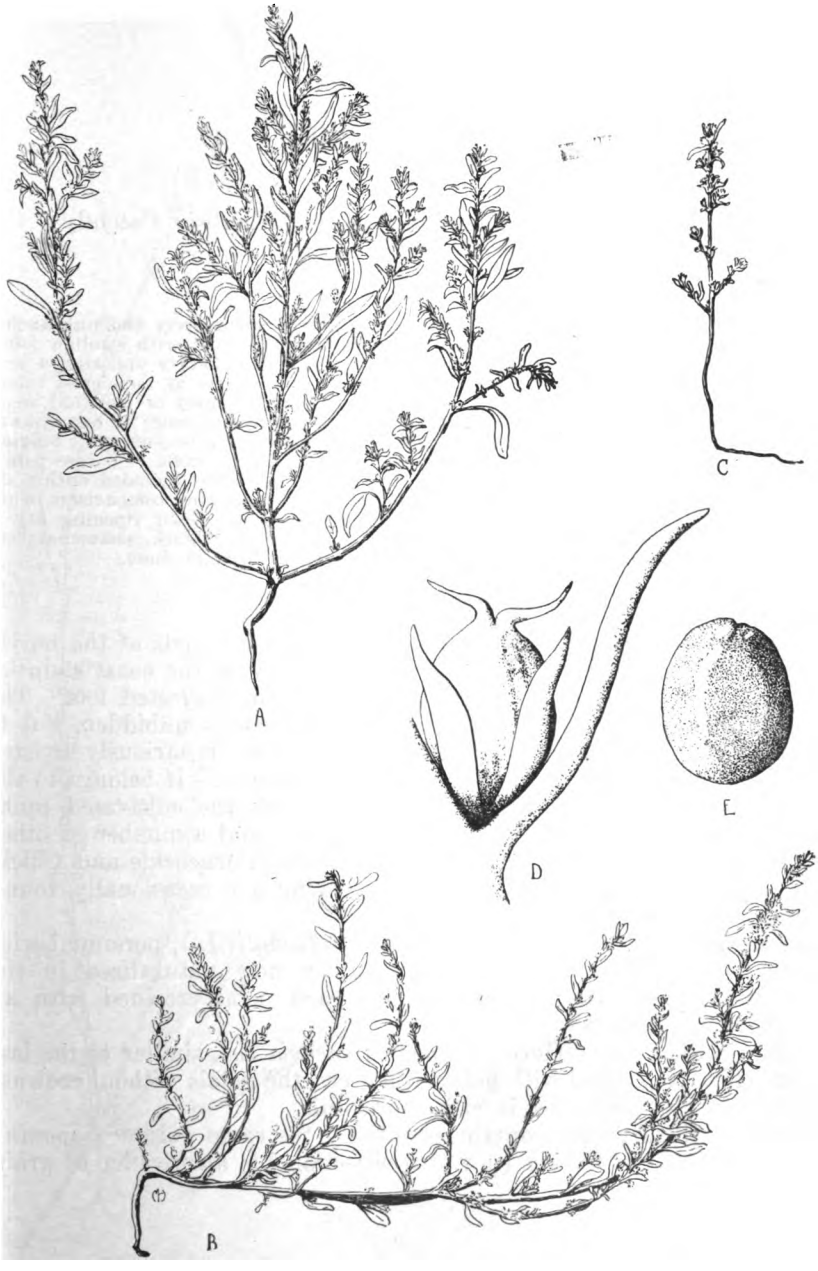

FIG. 32. Tumbleweed (*Amaranthus graecizans* L.): A, Habit of small plant of semi-erect type, x 1. B, Habit of reclining or spreading type, x 2/3. C, Seed-producing dwarf of dry, hard soil, x 1. D, Single flower consisting of sepals and ovary, only one bract shown, x 40. E, Seed, x 40.

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WINDMILL PINK.

(*Silene gallica* L. (= *Silene anglica* L.).)

English names: (1) Windmill Pink; (2) English Catchfly; (3) Small-flowered Catchfly.

DESCRIPTION.

Habit: Annual plant becoming 1 to 2 feet high, the stems erect and unbranched or bearing 1 to 2 small lateral branches, conspicuously jointed with swollen joints and more or less hairy, with some of the hairs glandular. *Leaves* opposite, 4 or 5 pairs to a stem, their leaf-stalks clasping the joints of the stem by broadened bases; the blade widening to the broad, rounded tip. *Flowers* grouped in terminal somewhat one-sided racemes, the flower stalks short and the raceme more or less spicate. Calyx tubular, ¼ to ⅜ inch long, formed of 5 united sepals, the tube somewhat bulging, 10-nerved, hairy, and persisting about the developing fruit. Corolla of 5 free petals, these white or pale pink, contracted to narrow claws, the latter included within the calyx-tube; the petals commonly more or less twisted (suggesting comparison to the vanes of a windmill). Stamens 10. Styles 3 or rarely 4. *Fruit* ripening dry to a capsule which ruptures at the top. *Seeds* many, small and black, somewhat bent and minutely roughened or tuberculate. Flowers from April to June.

DISTRIBUTION.

Introduced from Europe and now common in all parts of the northern United States. In California as yet mainly in the coast counties in fields and gardens and along roadsides or on neglected lots. The Windmill Pink is a weed in the sense that it comes unbidden, but to most people the delicate, pinkish flowers, with their curiously twisted petals, are things of interest rather than annoyance. It belongs to the Pink Family (Caryophyllaceae) which includes the cultivated pinks (carnations), belonging to the genus *Dianthus,* and a number of other plants that may become weeds. Two of these (Corncockle and Chickweed) are elsewhere described; the following are occasionally found spontaneous:

Bouncing Bet or Soapwort (*Saponaria officinalis* L.), perennial with large, rose-colored flowers, usually double, now naturalized in the Sacramento-San Joaquin delta region; each petal crowned with an appendage at the top of the claw.

Cow Cockle or Cow Herb (*Saponaria vacaria* L.), similar to the last botanically but annual with pale red flowers, the petals without crowns; Alameda, Colusa counties, in rich, moist soils.

Both of these plants contain essentially the same poison (*saponin*) which makes Corn Cockle (q. v.) so objectionable an invader of grain fields.

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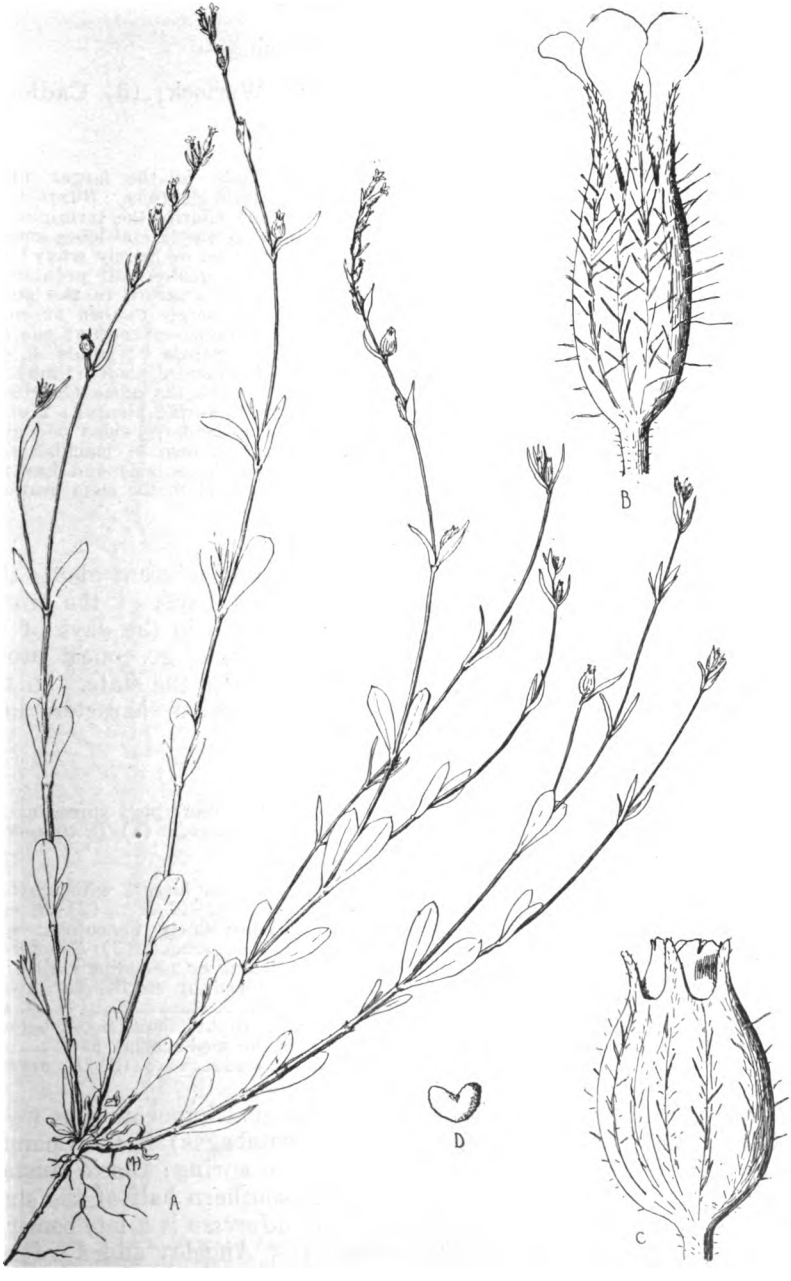

FIG. 33. Windmill Pink (*Silene gallica*): A, Habit of windmill pink; note the swollen joints enclosed by the leaf bases of the opposite leaves. B, Single flower, x 10. C, Fruiting calyx showing the opened capsule at the top, x 10. D, Seed, x 15.

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BLACK MUSTARD.

(*Brassica nigra* [L.] Koch.)

English names: (1))Black Mustard; (2) Warlock; (3) Cadlock.

DESCRIPTION.

Habit: Annual herb with green stems, 2–9 feet tall, in the larger plants usually widely branching, more or less hairy or at length glabrous. *Basal leaves* 3 to 8 inches long, deeply lobed nearly to the prominent midrib, the terminal lobe much the largest, 1 to 3 inches wide and rounded at the tip, the lateral lobes smaller, more or less pointed; margins of the lobes irregularly toothed or merely wavy; each basal leaf with a winged leaf-stalk. Upper stem leaves smaller, all pointed, on shorter stalks or the uppermost with their blades directly attached to the stems; lobes, if any, less deeply separated, the blades not rarely merely toothed or entire. *Flowers* bright yellow, ¼ to ⅜ inch broad, grouped in branching racemes at the ends of the branches, each individual flower-stalk ascending. Sepals 4; petals 4, each petal with a slender basal part (claw) and an expanded rounded blade (limb), the four limbs so disposed as to suggest a Maltese cross (hence the name Cruciferae, i.e., cross-bearers, applied to the Mustard Family of the flowering plants); 2 of the 6 stamens with shorter stalks; pistil 1, developing into a slender, 4-sided pod about ½ inch in length terminating in a sterile beak, the dark brown or blackish seeds found in the lower part of the fruit minutely pitted on the outside and having a sharp pungent taste. *Pods* with mature seeds closely parallel to the stem branches.

DISTRIBUTION.

Black Mustard is one of that group of European migrant plants that has accompanied the outgoing European to all parts of the world. This group of vagrants early settled in California in the days of the Mission Fathers and has prospered so mightily as to give most people the notion that its members are truly indigenous to the state. In this aggressive host are several mustards with distinctive characters indicated in the following key:

Key to the Weedy Mustards.

Leaves, or some of them, with basal lobes clasping the stem; pods spreading---(1) *B. campestris*

Leaves without clasping bases.

Mature pods appressed to the stem.

Leaves pinnatifid with large terminal lobes; racemes hirsute with scattered hairs; seeds dark brown or nearly black---(2) *B. nigra*

Leaves pinnate, the divisions subequal; racemes finely tomentose; seeds lighter---(3) *B. adpressa*

Mature pods standing out from the stems on spreading or ascending stalks.

Pods bristly, constricted between the seeds, tipped by sterile, flat, sword-shaped beaks as long as the seed-bearing part---(4) *B. alba*

Pods smooth or rarely somewhat bristly, only slightly constricted between the pods; sterile beaks ½ or less as long as the seed-bearing part---(5) *B. arvensis*

The several mustards mentioned are of unequal importance as weeds in California. *B. campestris* (cultivated rutabagas) is the Common Yellow Mustard so abundant in the valleys in spring; Black Mustard (2) is also very abundant especially in the southern half of the state, growing rankest upon heavy adobe soils; *B. adpressa* is a late comer to the state but is now established about Los Angeles and Professor Abrams informs me has been recognized in the Santa Clara Valley; White Mustard (4) is of slight importance as yet but may occasionally be found as an escape from cultivation when its pale brown seeds with mild flavor contrast sharply with the dark, sharp-tasting seeds of

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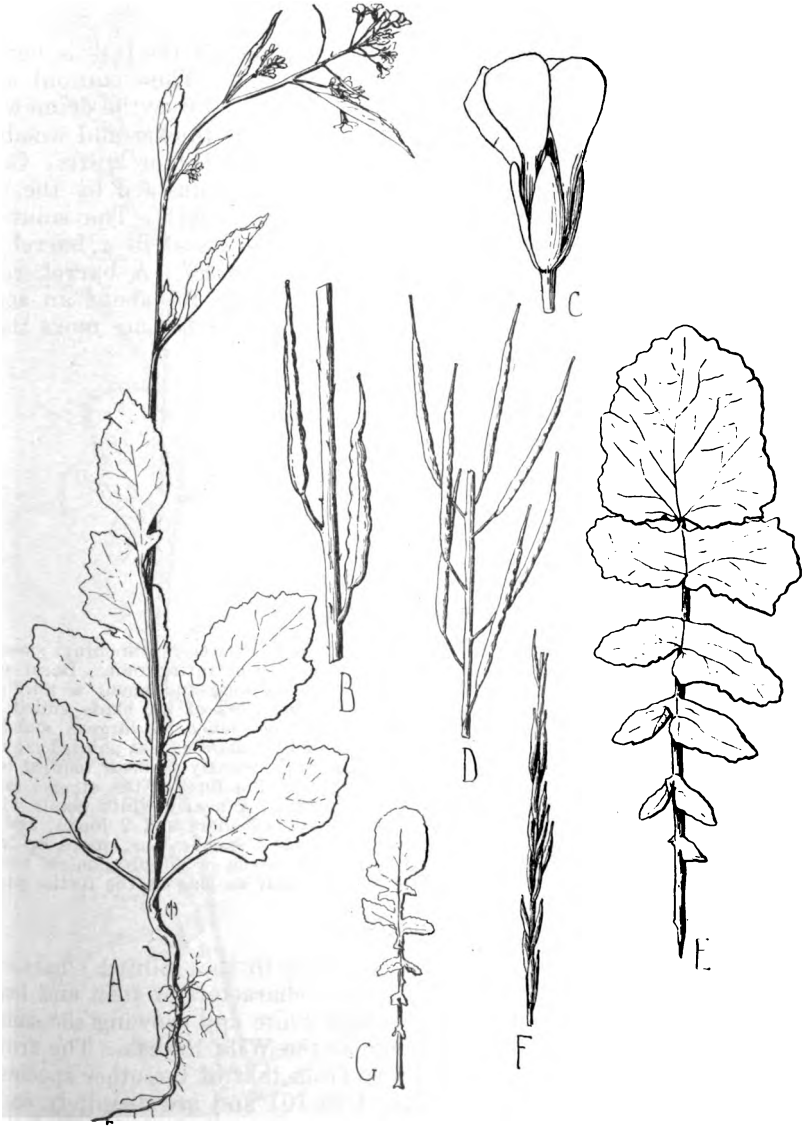

FIG. 34. Black Mustard (*Brassica nigra*) : A, Habit of *B. nigra*. B, Pods of same. C, Flower of black mustard, x 4. D, Part of seed-stalk of *B. campestris*. E, Leaf of same. F, Part of seed-stalk of *B. adpressa*. G, Leaf of same.

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B. nigra. The last species mentioned is the Common Charlock of the eastern states and is gradually spreading on the coast where it was introduced many years ago.

CONTROL.

Control of mustards requires early watchfulness if the task is not to become time consuming and laborious handwork. These annual and biennials when young are soft and juicy, easily cut by scythe or mower, but, as the fruits mature, the stems become notably thicker and woodier and have to be chopped or grubbed out with stout hoe or knife. Considerable success has been achieved in combatting mustard by the use of iron sulphate solution (copperas or green vitriol). The solution is prepared by dissolving 100 pounds of the chemical in a barrel of water, straining and spraying through a fine nozzle. A barrel, containing 52 gallons of this solution, will be enough for about an acre. The spraying is practically useless after the plants become more than ten inches or a foot high.

WILD RADISH.

(*Raphanus sativus* L.)

English name: (1) Wild Radish.

DESCRIPTION.

Habit: Tall weed, usually biennial in California, with freely branching, smooth stems ascending 1 to 3 feet high from a fleshy, deeply penetrating root. Basal and lower stem leaves long-stalked, large, 2.5 to 12 inches long and about a third as broad, so deeply lobed as to appear compound but the lobes of the blade united by narrow wings along the prominent mid-rib; terminal lobe much the largest, rounded at the summit, its margin and the margins of the smaller more or less pointed lateral lobes, wavy-toothed. Upper stem leaves few and small, shortly stalked, toothed but scarcely lobed. *Flowers* ¾ inch broad, in racemes at the tops of the stems; each flower composed of 4 sepals and as many pink, purple, or nearly white petals with broad, flat tips traversed by purple veins, 6 stamens (2 short and 2 long), and a single pistil which develops into a fleshy pod, 1 to 3 inches long, more or less shallowly constricted at intervals between the 2 to 3 seeds or simply conical when single seeded; pod produced above as a sterile beak half as long as the fertile part.

DISTRIBUTION.

The Wild Radish has a very near relative in the Jointed Charlock (*R. raphanistrum* L.), a plant with similar characters of stem and leaf but the flowers yellowish as a rule, fading white and showing the same conspicuous, purple veins on the petals as the Wild Radish. The fruit of Jointed Charlock is quite distinctive from that of the other species; the pods contain a number of seeds (4 to 10) and are definitely constricted in the intervals between the seeds, giving the fruit a jointed appearance (moniliform shape).

CONTROL.

Same as for Yellow Mustard.

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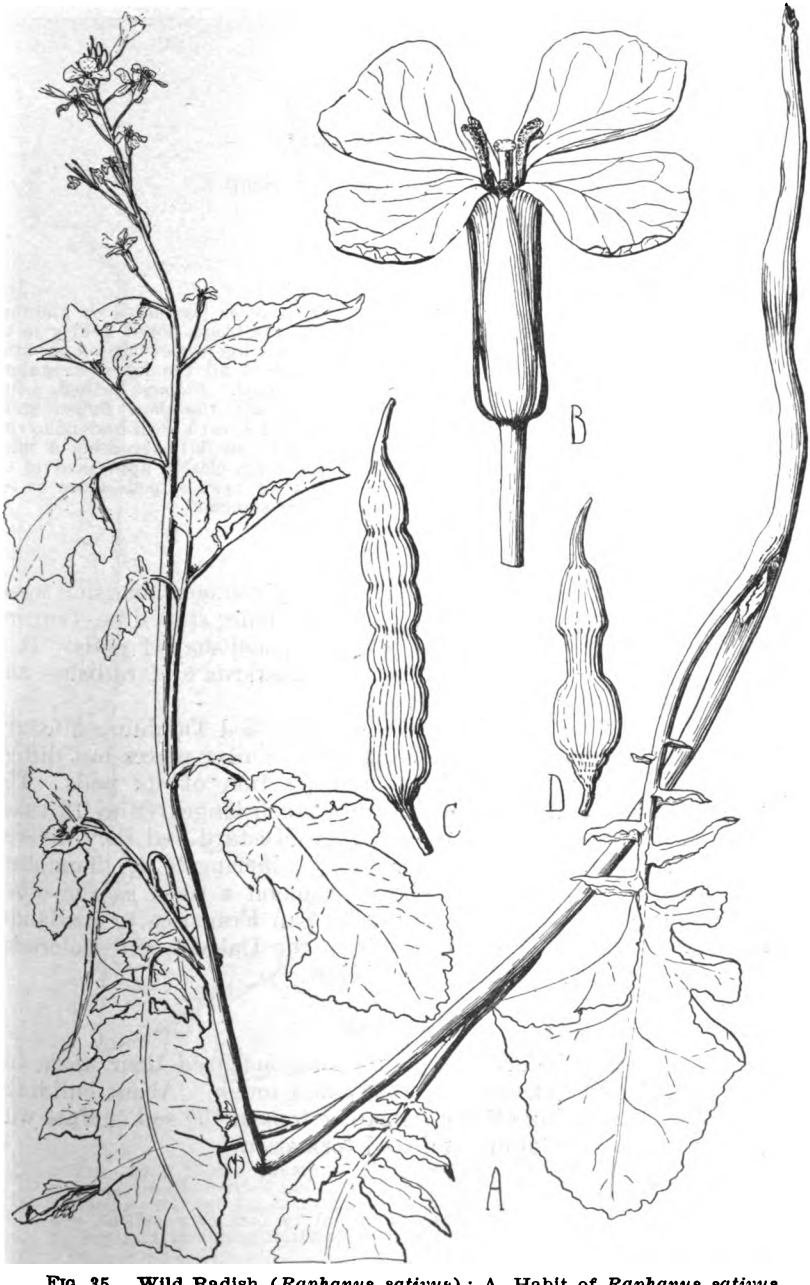

FIG. 35. Wild Radish (*Raphanus sativus*): A, Habit of *Raphanus sativus*. B, C, D, Flower and fruits of *R. raphanistrum*.

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HEDGE MUSTARD.

(*Sisymbrium officinale* [L.] Scop.)

English name: (1) Hedge Mustard.

DESCRIPTION.

Habit: Annual with erect stem, ½ to 4 feet high, more or less hairy or glabrous, its few rigid branches widely spreading. *Leaves* with the blades lobed nearly to the midrib, the 3 to 6 pairs of lateral pointed lobes appearing somewhat as separate leaflets below the large, blunt, terminal lobe; margins of all the lobes irregularly toothed; lower leaves on long stalks, the upper short-stalked. *Flowers* yellow, ⅛ inch broad, grouped in spike-like racemes disposed in a panicle, the short flower stalks (pedicels) at first somewhat spreading. Sepals 4; petals 4, each with a slender claw and broad summit; stamens 6, two short and four long; pistil 1, becoming a thick-walled, more or less hairy, tapering pod, ½ to ¾ inch long, closely appressed to the axis when mature. The old flowering branches and their rows of pods more or less purple tinged. Flowering and fruiting throughout the summer.

DISTRIBUTION.

Hedge Mustard, a native of Europe, is a very common roadside weed, especially prominent in mid-summer when its long, spike-like, fruiting branches are densely covered with the small, awl-shaped pods. It is not a field weed like its relatives, the true mustards and radishes and must be controlled by other means.

A near relative of Hedge Mustard is the so-called Tumbling Mustard (*Sisymbrium altissimum* L.), which grows in similar places but differs from Hedge Mustard in the shape and position of its pods. The cylindrical pods of Tumbling Mustard are much longer (8 to 12 times as long) than the awl-shaped pods of Hedge Mustard and they diverge from the stem when ripe rather than closely adhering to it. Tumbling Mustard does not seem as yet to be as common a weed as the other species, though we have records of it from San Francisco to Redlands. It is considered one of the worst weeds in the Dakotas and Colorado. Control: Same as for Hedge Mustard below.

CONTROL.

Mow the roadsides before the plants have matured their seeds for later the stems become excessively woody and tough. About buildings or along footpaths, hoeing off the immature tops at the soil surface will prevent new shoots developing and seed formation.

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FIG. 36. Hedge Mustard (*Sisymbrium officinale*): A, Habit of hedge mustard, medium-sized plant, x 1. B, Dwarf of dry, hard soil but capable of flowering and seed formation, x 1. C, Leaf of tumbling mustard, x 1; compare leaf outline with that of hedge mustard. D, Fruit of hedge mustard, x 4. E, Fruit of tumbling mustard, x 1.

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HOARY CRESS.

(*Lepidium draba* L.)

English name: (1) Hoary Cress.

DESCRIPTION.

Habit: Perennial with erect or ascending stems, 1 to 1.5 feet high, somewhat hairy and branching above the middle. *Leaves* oval or oblong, ½ to 2 inches long and an inch wide, with blunt ends and finely toothed margins. *Lower leaves* very short stalked, the upper clasping the stems by broad bases that develop ear-shaped lateral lobes (auricles). *Leaves* on the flowering branches smaller and narrower. *Flowers* white, small, ⅛ inch broad or less, borne on slender thread-like flower-stalks (pedicels) that spread widely from the axis; the several flowering branches approximately arising to the same level and the inflorescence more or less flat-topped (corymb inflorescence). Sepals 4, blunt; petals 4, each with a slender basal claw and broad summit; stamens as a rule 6 (two short and four long) but not rarely fewer. Style solitary, thread-like, about as long as the ovary. *Ovary* developing into a pod about 1/16 inch broad, at maturity standing out from the flowering branch nearly at right angles on the end of its flower-stalk. *Fruit* containing two flattened seeds.

DISTRIBUTION.

Hoary Cress is becoming one of the worst plant enemies of the beet grower about Oxnard, Ventura County, where it is reported to be a promising competitor with Orchard Morning-glory for popular disfavor. It is now established from Yreka to Los Angeles and perhaps elsewhere in the interior but as yet confused with other *Lepidium* species of weedy habit. The following key will aid in distinguishing these spontaneous "pepper-grasses" or "cresses:"

Key to the Weedy Pepper-grasses.

Perennial of hoary aspect; fruit not notched at the base of the style nor winged by a thin sterile border.....(1) *L. draba*
Annuals; fruit notched above, the base of the style inserted in the cleft.
  Flowers without petals; plant prostrate or reclining.....(2) *L. bipinnatifidum*
  Flowers with petals; plants with erect or ascending stems.
    Individual flower-stalks (pedicels) round.....(3) *L. medium*
    Individual flower-stalks flattened.....(4) *L. nitidum*

It is altogether probable that still another weed of this genus is present in California and will sooner or later be recognized: *L. campestre*—Field Pepper-grass or Cow-cress—one of the commonest impurities in lawn seed mixtures; a stout annual or biennial, somewhat like Hoary Cress, but with the fruit winged and notched, a very minute style inserted in the notch; native of Europe.

Hoary Cress is an immigrant from the Old World. The second species comes to us from South America and is now widespread in California, growing in paths, hard soil about buildings, and along roadsides. Both of the other species mentioned in the key are native to the western United States, No. 3 ranging east to Texas, No. 4 restricted to the Pacific slope. The former, known as Tall Pepper-grass, becomes 1 to 2 feet high; the latter, less than a foot tall, is the Common Pepper-grass or Tongue-grass, on all our grassy plains, hills and valleys.

CONTROL.

The annual pepper-grasses present little difficulty to the farmer compared to Hoary Cress; their small root systems are easily dislodged

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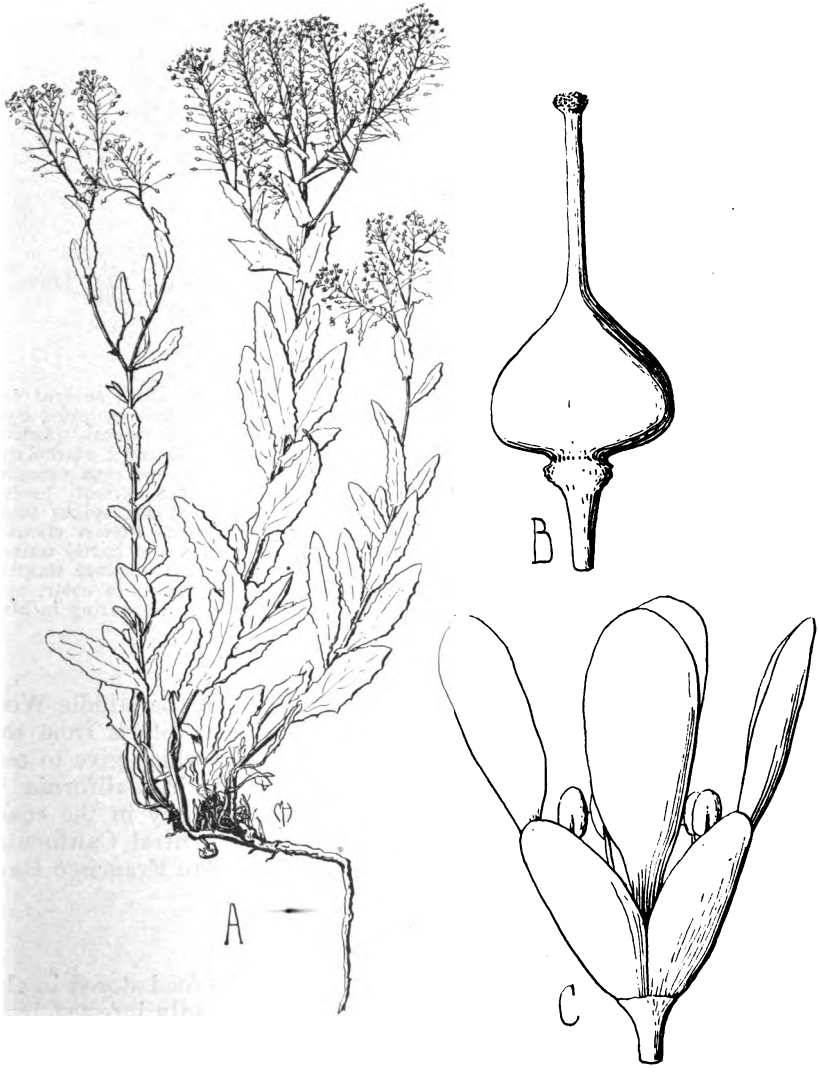

FIG. 37. Hoary Cress (*Lepidium draba*) : A, Habit of plant, natural size. B, Ovary and style, x 40. C, Flower, x 40.

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from the soil by a light cultivator or harrow or they may be hoed off along walks and fences. Hoary Cress is an altogether different matter; its tough, deeply penetrating and widely spreading, cord-like roots, from which the stems arise, are difficult to eradicate, while its abundant seeds ensure rapid multiplication. When it grows in a crop like sugar-beets, hand pulling is about the only measure practicable, care to be taken to pull up as much of the root system as possible.

WILD LIQUORICE.

(*Glycyrrhiza lepidota* var. *glutinosa* Watson.)

English names: (1) Liquorice; (2) Wild Liquorice; (3) Devil's Shoe-string; (4) Sweet Root.

DESCRIPTION.

Habit: Perennial herbs with thick, sweet roots, the latter becoming several feet long and difficult to eradicate. *Stems* 2 to 3 feet high, erect and bearing large, compound leaves and dense, cylindrical spikes of yellowish-white flowers. Leaves composed of 6 to 8 pairs of leaflets along the midrib with an odd leaflet at the tip; leaflets short-stalked, 1 to 1.5 inches long, with prominent midrib and even margins, pointed at the tip. Stipules small but persistent. Foliage and stems more or less sticky or glutinous (whence the varietal name) and spotted. Flower spikes borne in the leaf-axils on stalks shorter than the leaves, many flowered. *Flower* about ½ inch long, its calyx very glandular, 5-cleft, the 2 upper lobes shorter or partly united, and all segments sharp toothed. Corolla longer than the calyx, the banner slanting forward. Pod ½ inch long, covered with hooked prickles, red-brown in color, containing 2 to 6 seeds and terminated by the long persistent style. Flowering in May and June.

DISTRIBUTION.

The typical form of the Wild Liquorice, a native of the Middle West and now occurring as a weed to the Atlantic Coast, differs from the Pacific Coast variety in lacking the glandular hairs which give to our plant its characteristic, clammy feel. The variety in California is distributed from Humboldt County to Riverside, mainly in the coast region but reaching the foothills of the Sierra in central California. It has become very troublesome in the region about San Francisco Bay, growing luxuriantly on rich, moist soils.

CONTROL.

Prevent vegetative growth, thereby exhausting the food stored in the roots. Hogs are said to eat the roots greedily and badly infested land may be fenced and used as a run for these animals for a season.

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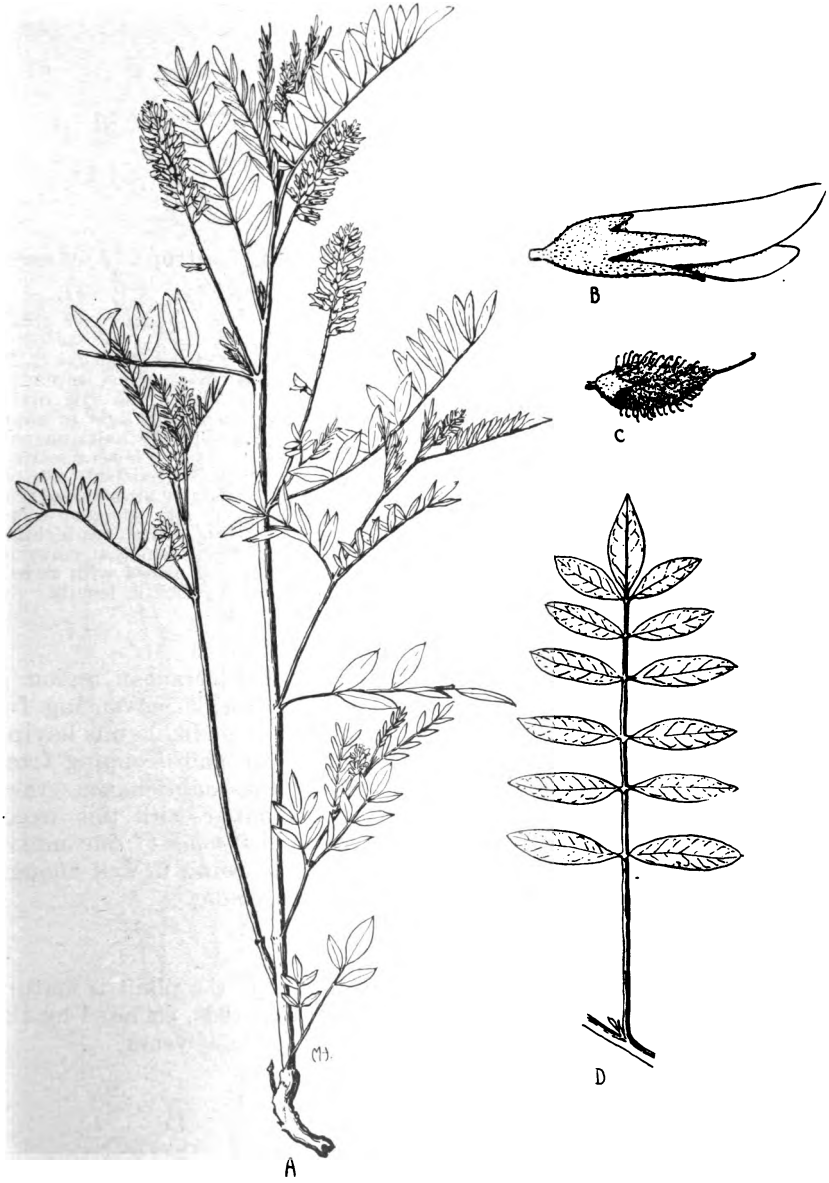

FIG. 38. Wild Liquorice (*Glycyrrhiza lepidota* var. *glutinosa*): A, Habit showing foliage and inflorescence characters, x 2/3. B, Single flower, x 8. C, Fruit, x 5, covered with brownish, hooked prickles and superficially resembling a cocklebur. D, Leaf, x 2.

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GROUND BURNUT.

(*Tribulus terrestris* L.)

English names: (1) Ground Burnut; (2) Land Caltrop; (3) Lesser Caltrop.

DESCRIPTION.

Habit: Mat-forming annual with many prostrate branching stems 10 inches to 2.5 feet long, conspicuously jointed, slender and weak, bearing short, silky, spreading hairs, or some of the stems ascending. *Leaves* numerous, compound, 1.5 to 2 inches long, formed of 5 to 7 pairs of leaflets, each leaflet about ¼ inch long, oval in shape and ending bluntly, grayish-green in color due to the covering of silky hairs on both surfaces; leaf-stalks short with a pair of small stipules at base. *Flowers* solitary in the leaf-axils, about ½ inch broad, short stalked; calyx of 5 persistent, jointed, hairy sepals; corolla of 5 yellow petals, longer than the sepals and broadening from the base, early falling away; stamens 10, alternately longer and shorter; ovary 5-celled, covered with erect hairs and surmounted by a short style ending in a 5-ridged stigma; the ovary ripening into a spiny fruit about ½ inch broad which at maturity splits into 5 parts (carpels), each containing 3 to 5 seeds and armed with 2 to 4 spreading, unequal and rigid, often curving spines, the longest ¼ inch in length.

DISTRIBUTION.

This truly pernicious immigrant from the Mediterranean region is rapidly extending its area of occupation in California, advancing for the most part along the railway rights-of-way, the bur-like fruits having been engaged by the hairy coats of cattle or sheep and dropping from stock cars. It is to be wished that all of the maintenance crews employed by the railroads might be made familiar with this weed. Unfortunately on the vegetative side it resembles some of our native species of *Lotus* so closely that many people, knowing it well enough in its mature bur-bearing state, mistake it when young.

CONTROL.

Hoe out all specimens as soon as recognized. If the plant is mature and in fruit, be sure to burn the whole since the seeds, enclosed by the hard, woody carpels, may remain alive for a couple of years.

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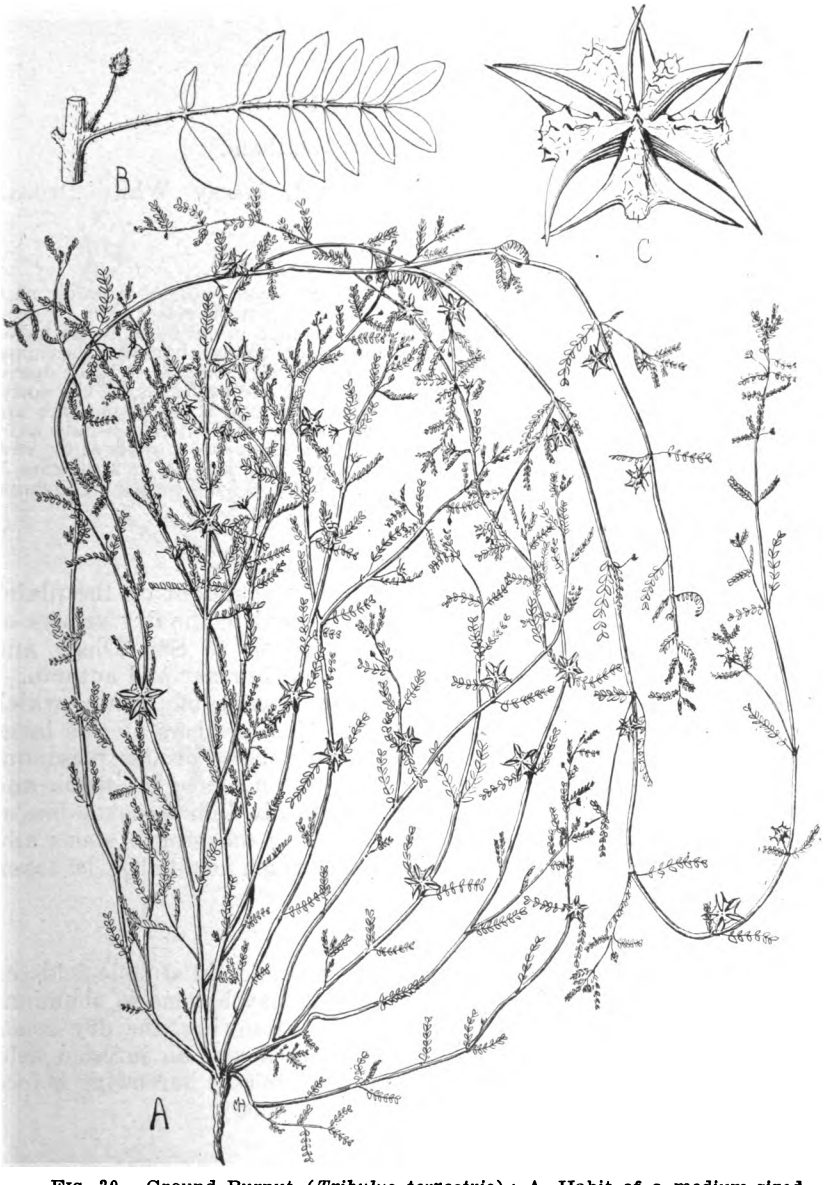

FIG. 39. Ground Burnut (*Tribulus terrestris*): A, Habit of a medium-sized plant showing the long, whip-like branches and burs, x 1. B, Leaf with a flower bud in the axil, x 5. C, Bur composed of the 5 woody carpels, x 5.

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TURKEY MULLEIN.

(*Eremocarpus setigerus* Bentham.)

English names: (1) Turkey Mullein; (2) Wooly White Drouth Weed; (3) Dove Weed.

DESCRIPTION.

Habit: Low spreading annual herb with forking stems, usually forming mats 1 to 2 or more feet across but occasionally with ascending stems a foot high. *Leaves* thick, 3-nerved from the base, oval-pointed to nearly round in outline, ¼ to 1.5 inches long on leaf-stalks of about equal length, the lower leaves alternate, the upper opposite. Both stems and leaves harsh to the touch and light gray in color due to a dense coating of forked, bristly hairs. *Flowers* small, inconspicuous, of two sorts: *staminate*, composed of a calyx of 5 or 6 sepals enclosing 6 or 7 stamens; and *pistillate*, the latter without calyx or corolla and formed of a solitary, densely hairy ovary and style. The staminate flowers are grouped in flat-topped clusters at the ends of the stem branches; the pistillate flowers are solitary or occur 2 or 3 together in the axils of the lower leaves. The ovary ripens to a dry capsule containing a single, smooth, shining, mottled seed about 1/10 inch long.

DISTRIBUTION.

Widely distributed in California, especially abundant on the plains of the Sacramento and San Joaquin Valleys and in the dry valleys of the Coast Range, from Tehama County south to San Diego and Imperial counties. Especially common in late summer and autumn.

Turkey Mullein belongs to the Spurge Family of plants, which includes the well-known Castor-oil Plant. The members of this large family of flowering plants contain, as a rule, more or less poisonous principles and Turkey Mullein is no exception, since its stems and leaves contain a narcotic poison. The California Indians made use of the bruised herbage as a fish poison, throwing the broken stems and leaves into streams and stupefying the fish which could then be taken by hand.

CONTROL.

As a weed, Turkey Mullein is chiefly a nuisance in stubble-fields or on summer fallowed land. In such places it may become so abundant as to interfere with subsequent plowing or harrowing, the dry stems clogging farm implements. It is shallow-rooted and an infested field may be easily cleaned in the beginning of summer by harrowing before the plants have attained much size or become woody.

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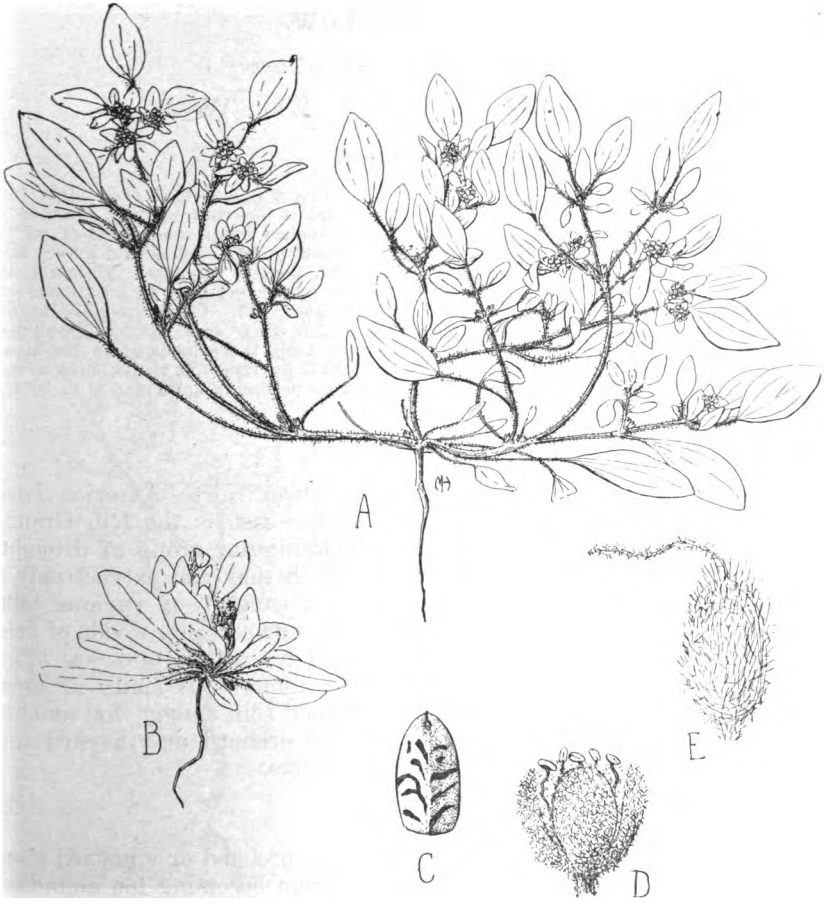

FIG. 40. Turkey Mullein (*Eremocarpus setigerus*) : A, Habit of plant. B, Seedling. D, Staminate flower. E, Pistillate flower. C, Seed.

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ALKALI MALLOW.

(*Sida hederacea* [Dougl.] Torrey.)

English names: (1) Alkali Mallow; (2) White Weed.

DESCRIPTION.

Habit: Low herbs with short, ascending branches, 6 inches to 1 foot high, from the summit of a deep-seated tap-root. Erect shoots bearing simple rounded or broadly oval leaves with squarish bases, ¾ to 2 inches broad and toothed on the margins, borne on slender leaf-stalks about an inch long. Both stems and leaves more or less yellow due to abundant, scurfy scales and forked (stellate) yellow hairs. *Flowers* on stalks as long as the leaves, solitary in the leaf-axils or in small clusters, each flower stalk jointed and at length turning downward. Calyx broadly funnel-form, its 5 sepals united for about half their length, their free tips wedge-shaped. Corolla of 5 cream-colored free petals, ½ to ¾ inch long, twice as long as the sepals and twisted in the bud. Stamens numerous, united by their filaments into a tube about the 6 to 10 styles. *Ovary* superior, when ripe becoming split into 6 to 10 dry, 1-seeded, somewhat triangular fruits.

DISTRIBUTION.

Alkali Mallow is a native plant of western North America from Washington to Lower California and as far east as the Rio Grande Valley in western Texas. It is one of that singular group of drought-enduring plants, thriving in soils from which they can extract only a minimum amount of water because of its content of various salts (= alkali), an amount quite insufficient for our common weeds of field and garden. These so-called halophytes (i. e., salt plants) are often loosely written about as salt-loving (halophilous) but many of them at least are quite capable of appreciating good soil, among this number Alkali Mallow, which can become a pest in orchard or vineyard and hard to kill out because of its deep-seated roots.

CONTROL.

Usually the same cultivation that keeps an orchard or vineyard clear of other weeds will prevent White Weed from becoming too abundant but, if it attains a firmer foothold, recourse must be had to digging out the larger roots and thereafter hoeing off whatever shoots appear.

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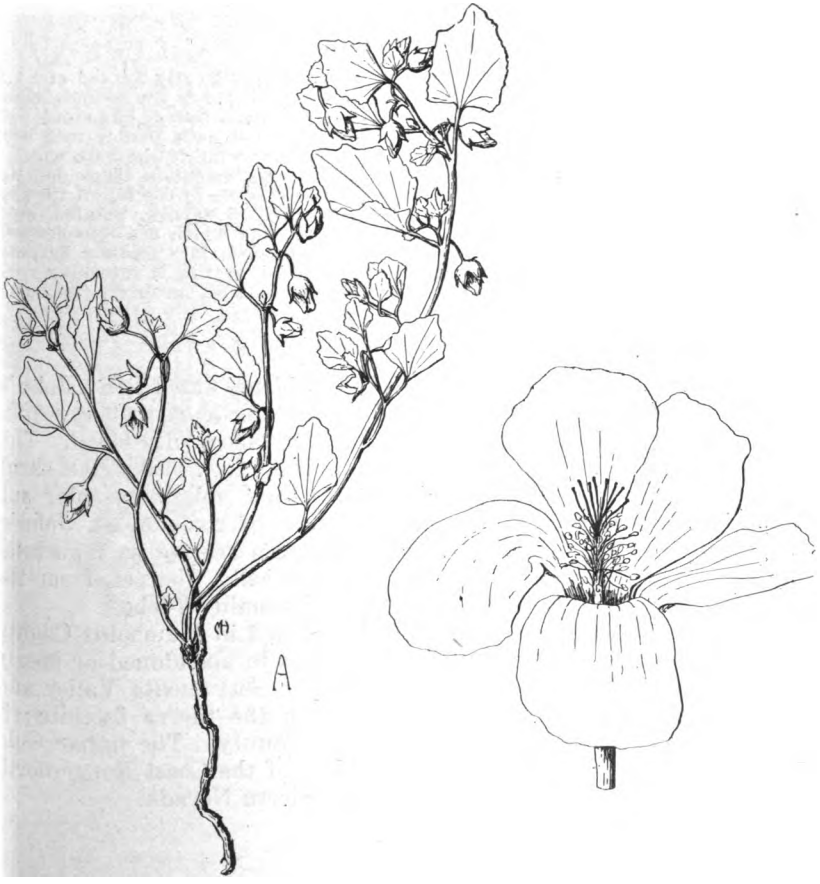

FIG. 41. Alkali Mallow (*Sida hederacea*): A, Habit of a small-sized plant B, Single flower, enlarged, to show the characteristic stamen tube surrounding the styles.

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COMMON ST. JOHN'S-WORT.

(*Hypericum perforatum* L.)

English names: (1) Common St. John's-wort; (2) Speckled John; (3) Herb of St. John; (4) Klamath Weed (in Humboldt County).

DESCRIPTION.

Habit: Perennial with erect, freely branching stem, prominently jointed and 1 to 2.5 feet high, herbaceous above but woody at the base, the roots tough and fibrous. Younger stems 2-edged with a pair of narrow lateral wings. *Leaves* numerous, light green, narrow (linear) or oblong, ½ to 1 inch long and not more than ⅛ inch wide, opposite one another, pointed at the tip and slightly narrowing to the base which is attached directly to the stem joints, the leaf surface with numerous black dots and smaller translucent spots. *Flowers* numerous in loose clusters at the top of the stem branches, each flower about an inch broad, composed of 5 narrow, pointed, green sepals about ½ as long as the 5 oval, bright yellow petals which are conspicuously black-dotted near their margins; stamens numerous, grouped in 3 clusters by union of their stalks, the anthers black-dotted; ovary not lobed, bearing 3 spreading styles and developing into a capsule that breaks into three parts at maturity, freeing the minute, dark brown seeds.

DISTRIBUTION.

There are two or three native plants in California allied to St. John's-wort and one of these is justly feared by the stockmen as being quite as serious a nuisance as the European plant above described. This native plant is popularly known as Gold Wire, a low, bushy half-shrub about a foot high, with many wiry stems light yellow in color and bearing bright yellow flowers similar to those of common St. John's-wort except that the black dots upon the petals are not so numerous. Gold Wire (*H. concinnum* Benth.) is technically distinct from the introduced weed by its capsule at maturity becoming 3-lobed.

The Old World species is now well established in Humboldt County where Mr. J. P. Tracy reports it as abundant in abandoned or poorly tilled land; it has invaded the interior in the Sacramento Valley and already is reported from Nevada County in the Sierra foothills; it has also become established in Santa Cruz County. The native Gold Wire is found on the drier slopes and ridges of the Coast Range north of San Francisco Bay and in the northern Sierra Nevada.

CONTROL.

Both of these species should be carefully watched for and cut out root and branch wherever found since the herbage is poisonous to sheep and cattle and is reported as toxic to horses. Considerable loss is due each year to stock, generally sheep, grazing these plants; it appears that the danger is greatest during the passage of stock along mountain trails as they are driven from one range to another.

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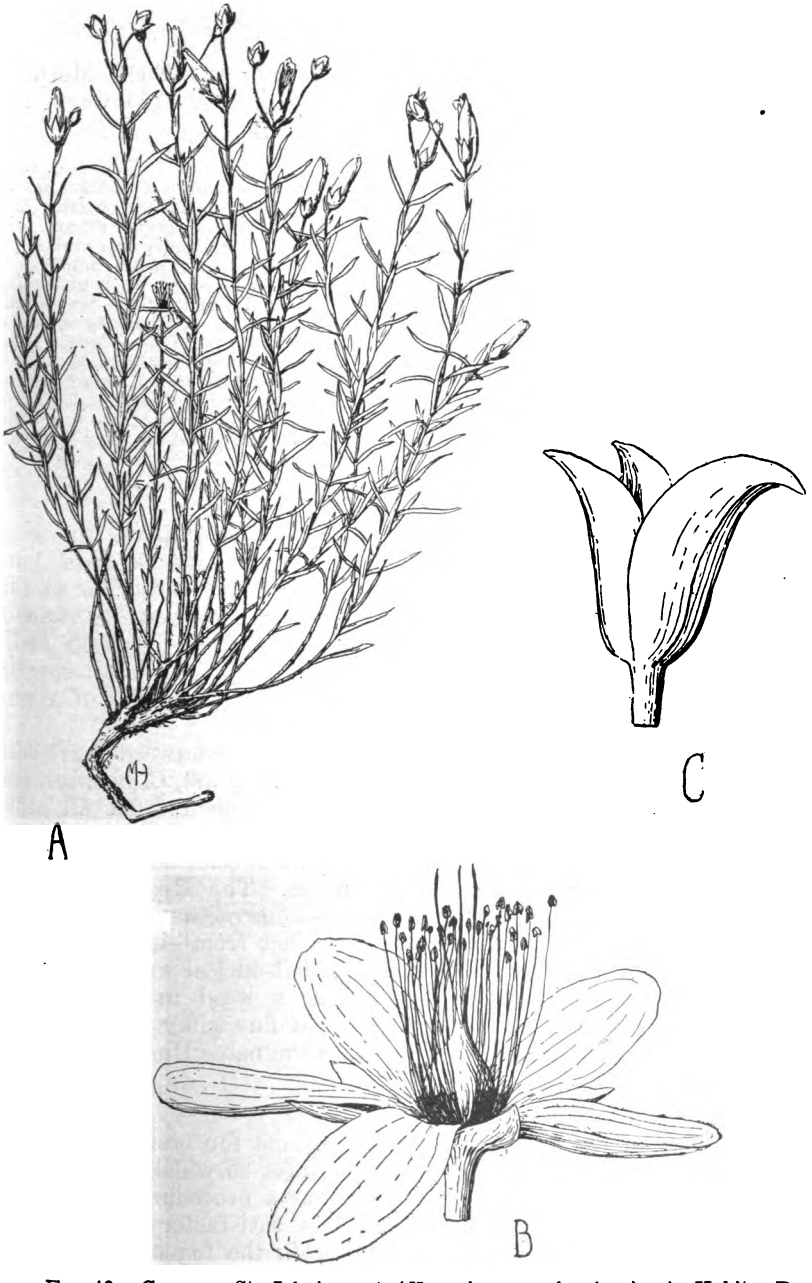

FIG. 42. Common St. John's-wort (*Hypericum perforatum*): A, Habit. B, Flower, slightly enlarged (the characteristic black dots, found along the margin of the petals, are omitted from the figure). C, Capsule after dehiscence and release of the seeds.

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ORCHARD MORNING-GLORY.

(*Convolvulus arvensis* L.)

English names: (1) Orchard Morning-glory; (2) Field Morning-glory; (3) Field Bindweed; (4) European Bindweed; (5) Corn-bind.

DESCRIPTION.

Habit: Herbaceous spreading or sprawling vine with slender, whip-like, smooth and prostrate stems, 1 to several feet in length, simple or branched, arising from long, fibrous roots that may descend deeply into the soil and give rise at any place from adventitious buds to the aerial, leafy stems. *Leaves* on slender leaf-stalks, ½ to 1 inch long, the entire blue-green blades twice as long, their bases squarish or flaring, narrowing very gradually upward to the generally blunt or rounded tip; venation prominent. *Flowers* borne on slender stalks in the axils of the leaves, each stalk 1 to 4-flowered, a pair of flowers more often occurring, and bearing a pair of tiny bracts at about its middle. Each flower composed of a calyx of 5 united sepals with only their rounded summits free, a large funnel-shaped corolla, pale pink or white within and purplish on the outside, 1 inch long and about as broad, bearing the 5 stamens attached to its inner surface and surrounding the single pistil with its long, thread-like style and small, 2-celled ovary which ripens into a rounded capsule containing usually 4 dark-brown seeds, these flattened on one side and rounded on the other.

DISTRIBUTION.

The Orchard Morning-glory has been officially proclaimed the worst weed in California and no doubt there are many orchardists, vineyardists, bean and sugar-beet growers, who would subscribe to this verdict. No other pest is comparable to Morning-glory in its vigor of vegetative growth and tenacity of life and a piece of land badly infested is a serious problem indeed to the owner. The plant spreads mainly by its cord-like roots, a small piece being capable of reproducing the plant.

Besides Field Morning-glory, at least three other bindweeds have been reported as nuisances in the state: *Convolvulus sepium, C. incanus,* and *C. pentapetaloides.* The last is easily distinguished from all other morning-glories by its minute purplish flowers about ⅓ inch long with the corollas deeply five-cleft; it is a European species now naturalized in Contra Costa and San Joaquin counties. The Hedge Bindweed (*C. sepium*) has a bad reputation in the east, one of the common names applied to it being Devil's Vine. It is distinct from either species so far mentioned by the pair of large bracts that enclose and conceal the calyx. *C. incanus,* doubtfully reported as a weed in the Imperial Valley, is recognized by its dense coating of fine, silky hairs, making the herbage appear gray or whitish, whence the name Hoary Bindweed.

CONTROL.

So far, it must be admitted, effective means for besting Morning-glory have yet to be devised. Conditions differ so widely between the coastal counties and the interior valleys that a procedure which gives good results in one district may be less satisfactory in another. Experiments conducted by G. P. Gray within the fog belt about San Francisco Bay gave on the whole promising results with an arsenical spray (see Univ. California Exp. Station Circ. No. 168, Sept. 1917). Earlier, in 1911, Professor Bioletti worked at the problem of eradica-

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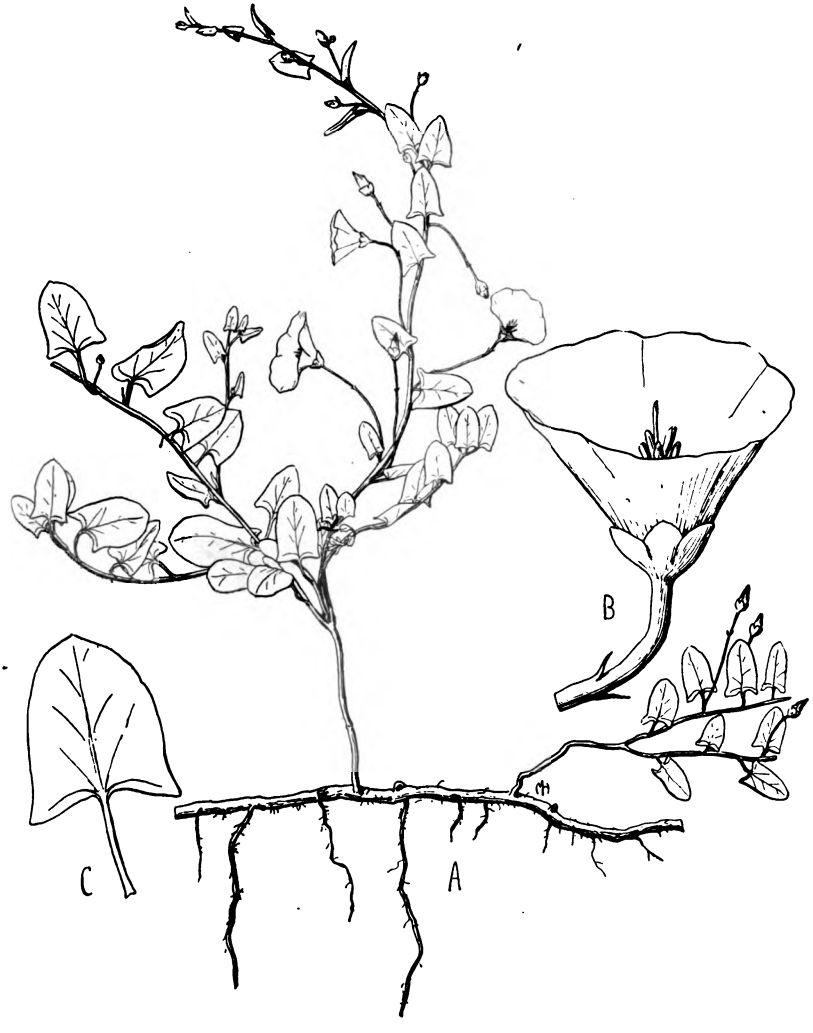

FIG. 43. Orchard Morning-glory (*Convolvulus arvensis*) : A, Habit showing deep-seated, horizontal roots and leafy shoots arising from adventitious buds. B, Flower. C, Leaf.

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tion at Davis, in the lower Sacramento Valley; he found the cost of clearing an acre of badly infested land to be about $9, the method being to run a weed cutter during the growing season at intervals with the blade set at a depth of four inches; it should be noted that this land was free of trees or vines and the problem very different from that presented in clearing land permanently under cultivation. The object in all attempted eradication is to prevent foliage formation. Morning-glory seems to be a highly effective food-making plant and even a little leafage will maintain life in the roots.

DODDER.

(*Cuscuta* sp.)

[Several species of *Cuscuta* are parasitic in California upon different plants—alfalfa, cockle-bur, rattle-weed, Baccharis, daisy, willow-herb, sow thistle, *Lotus*, *Carum*, wild buckwheat, samphire, *Ambrosia*—both wild and cultivated. Though differing by certain constant technical characters, all of the species are very similar in habit and appearance; it has, therefore, been thought best to include here only the generic description.]

English names: (1) Dodder; (2) Love-vine; (3) Strangle-weed; (4) Devil's-hair.

DESCRIPTION.

Habit: Annual leafless, rootless parasites growing upon various herbaceous and woody plants, the yellow or golden twining stems 1 to several feet in length, very slender, smooth and thread-like, bearing small, sucking disks by which attachment is effected with the host plant. *Flowers* small, grouped in clusters, the calyx and corolla white or faintly pink in color, each of 5 segments, the petals at least always united to form a tube upon the inner surface of which the 5 stamens are attached. *Ovary* globular, terminated by two short, erect or spreading styles and containing 2 cells, inside of which the small, round, gray or darker seeds mature, 1 or 2 in each cell. *Seeds* germinate in the ground, the young seedling developing a root and stem; the latter must quickly come into contact with some suitable plant about which to twine or the seedling soon perishes. If a suitable host is reached, attachment is made by the suctorial disks and the root quickly dies, all the needs of the dodder being henceforth met by the host. In addition to its reproduction by seeds, dodder may be widely spread by pieces of the stems being carried from place to place by various agencies since stem fragments above a certain minimum size may become attached to new hosts.

DISTRIBUTION.

Dodder becomes of importance to the California farmer mainly as a parasite of alfalfa. Of late it has been reported as injurious in the beet fields. Four species of *Cuscuta* are stated by Professor C. V. Piper (Forage Plants and their Culture, 354) to be harmful to alfalfa in the United States: *Cuscuta planiflora, C. indecora, C. epithymum,* and *C. arvensis,* the first species being the most injurious in the west. Our own examination has indicated *C. indecora* as the chief cause of trouble in California.

CONTROL.

Dodder may be regarded as a perfect example of an impure seed weed. Barring the possible but practically insignificant infestation due to mechanical transport of living stems from place to place, all of the Love-vine which unhappily yellows so many alfalfa fields in the

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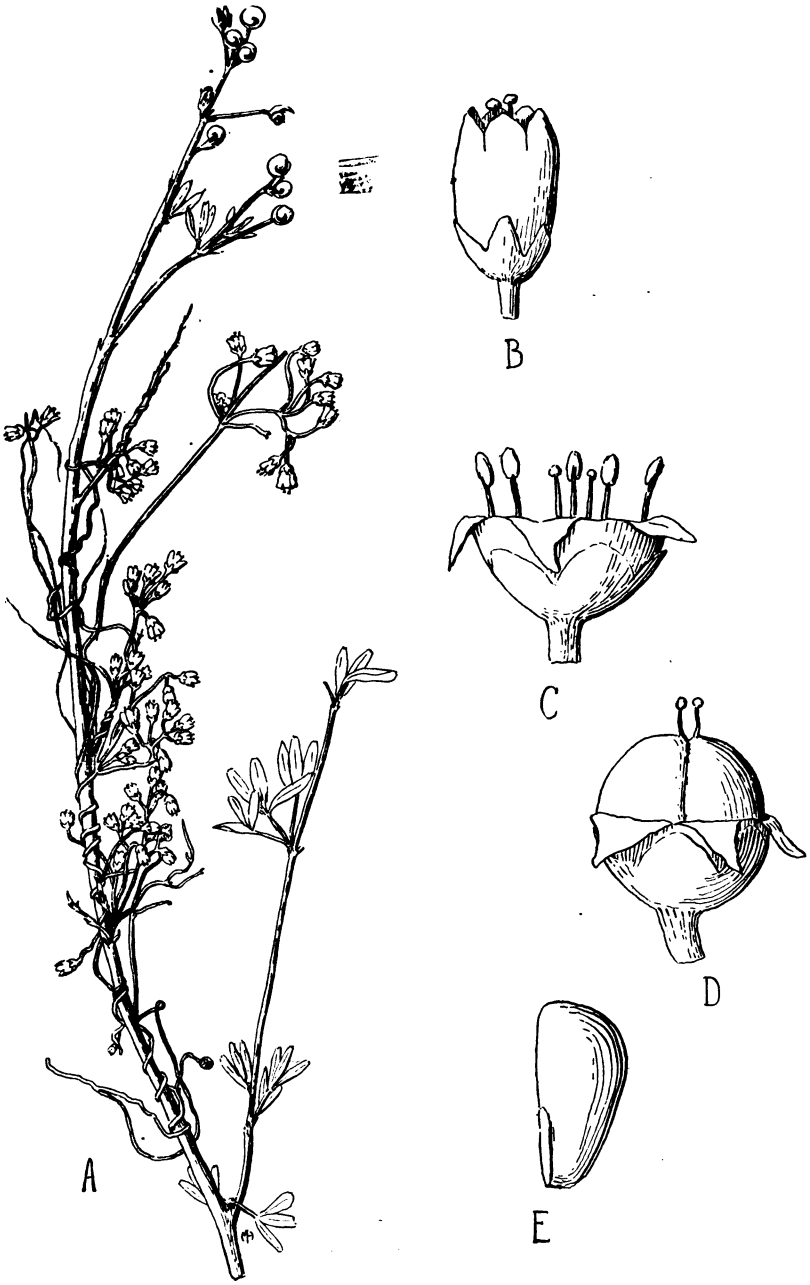

FIG. 44. Dodder (*Cuscuta* sp.): A, Stem of alfalfa parasitized by *Cuscuta*, x 20 (*C. indecora*). B, Flower, x 10 (*C. indecora*). C, D, Flower and fruit of *C. arvensis*, x 20. D, Seed of *C. arvensis*.

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state is due to sowing the seeds of the parasite along with the seed of the alfalfa itself. Every alfalfa grower should personally examine samples of seed supplied by the trade and reject all that show the yellow-brown seeds of the parasite. After infestation has occurred, remedies are not easily found. Patches of host and parasite may be burned but some of the seed of the parasite has probably escaped destruction. Dodder seed is remarkably retentive of life and may germinate in the soil after lying for two or three years. Badly infested areas are best plowed up and kept in some tilled crop for at least two years before again trying to grow alfalfa upon them.

BUCKTHORN WEED.

(*Amsinckia intermedia* F. & M.)

English names: (1) Buckthorn Weed; (2) Fiddle-necks; (3) Yellow Burweed; (4) Yellow Tarweed; (5) Fireweed; (6) Yellow Forget-me-not.

DESCRIPTION.

Habit: Annual herb with erect, simple or widely branching stems, 1.5 to 4 or even 5 feet high, bearing alternate ovate or strap-shaped entire leaves, 1.5 to 5 inches long, somewhat fleshy and traversed by prominent midribs, the lower leaves tapering to a leaf-stalk attached to the stem by a broad base. *Herbage* bristly with spreading, stiff, yellowish hairs that arise from an enlarged base, the hairs on the leaves somewhat shorter than those of the stems. *Flowers* numerous, grouped in terminal, one-sided, curling, spike-like inflorescences (whence the name Fiddle-neck), 4 to 10 inches long, the yellow or orange corollas 5-lobed at the flaring summit, about ⅛ inch broad, twice as long as the bristly, pointed, persistent sepals, and bearing on its inner surface the 5 stamens. Style solitary, attached at base in the center of the 4 lobes of the ovary, each of which becomes free, when its single seed is ripe, as a keeled nutlet about 1/10 inch long, its surface roughened or wrinkled.

DISTRIBUTION.

The number of common names applied to this native, orange-flowered relative of the garden Forget-me-nots bears witness to its widespread abundance. In some of the interior valleys of the state it is one of the commonest spring bloomers. In the orchards and vineyards it may be more of a benefit than a nuisance since the young stems are juicy, easily rotting when turned under by the plow and thus of considerable value as a green manure on sandy or adobe soils. When the stems grow rankly and are allowed to mature, they become dry and brittle and are then easily fired, so that in the grainfields of the San Joaquin and Sacramento valleys a frequent source of fire loss is due to these stalks with their tinder-like leaves. Much of the grainfield infestation is due to impure seed, the small, seed-like fruits of the Buckthorn Weed being easily overlooked since they somewhat resemble grains of wheat. Clean grain for seeding only should be sown, a rule which, if followed, would prevent many other troubles than merely the weed nuisance.

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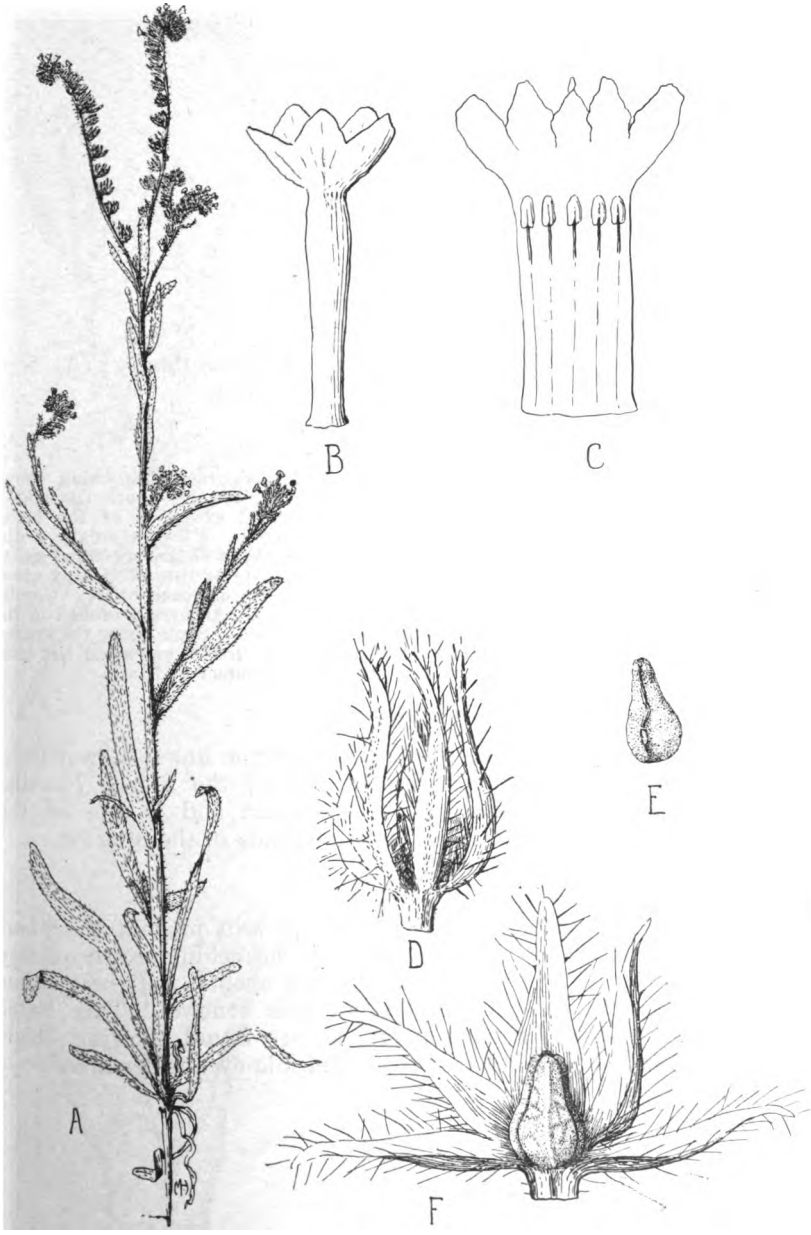

FIG. 45. Buckthorn Weed (*Amsinckia intermedia*): A, Habit of medium-sized plant. B, Corolla, entire, x 12. C, Corolla expanded, x 12. D, Calyx in fruit, x 12. E, Single nutlet enlarged. F, Group of nutlets exposed by spreading apart the sepals.

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WILD HELIOTROPE.

(*Heliotropium curassavicum* L.)

English names: (1) Wild Heliotrope; (2) Chinese Pusley; (3) Seaside Heliotrope; (4) White Weed; (5) Devil Weed.

DESCRIPTION.

Habit: Prostrate, fleshy perennial with smooth, grayish-green, branching stems, ½ to 3 feet long or longer. *Leaves* 1.5 to 3 inches long, broader above the middle and blunt at the tip, the leaf-stalk winged by downward extension of the blade, veins obscure, only the midrib showing in the thick blade. *Flowers* small, white, becoming lavender in age, yellow in the center and grouped in dense, one-sided spikes which coil at the tip (scorpoid); the spikes usually in pairs or threes. Calyx about half as long as the corolla, of 5 thick, blunt sepals, free from each other. Corolla of 5 united petals forming a tube which flares at the top. Anthers attached to the tube of the corolla by very short filaments, appearing sessile. Style none, the stigma convex and covering the top of the round ovary, which at first is not lobed but later splits into 4 one-seeded nutlets. Flowering through the summer and fall.

DISTRIBUTION.

Widely distributed in California from the Oregon line to Lower California and from the coast counties to east of the Sierra Nevada. Favors low, moist, saline flats along the coast and is one of the characteristic plants of much of the alkaline lands in the interior.

CONTROL.

Harrowing a field showing Wild Heliotrope will prevent the plant spreading but will not exterminate it since the branching crown quickly develops new shoots. Grubbing off the crowns about a half inch below the surface of the ground will prevent this renewal. This latter measure is practicable for such plants as are found growing about dooryards or along fences but is scarcely feasible over wider areas.

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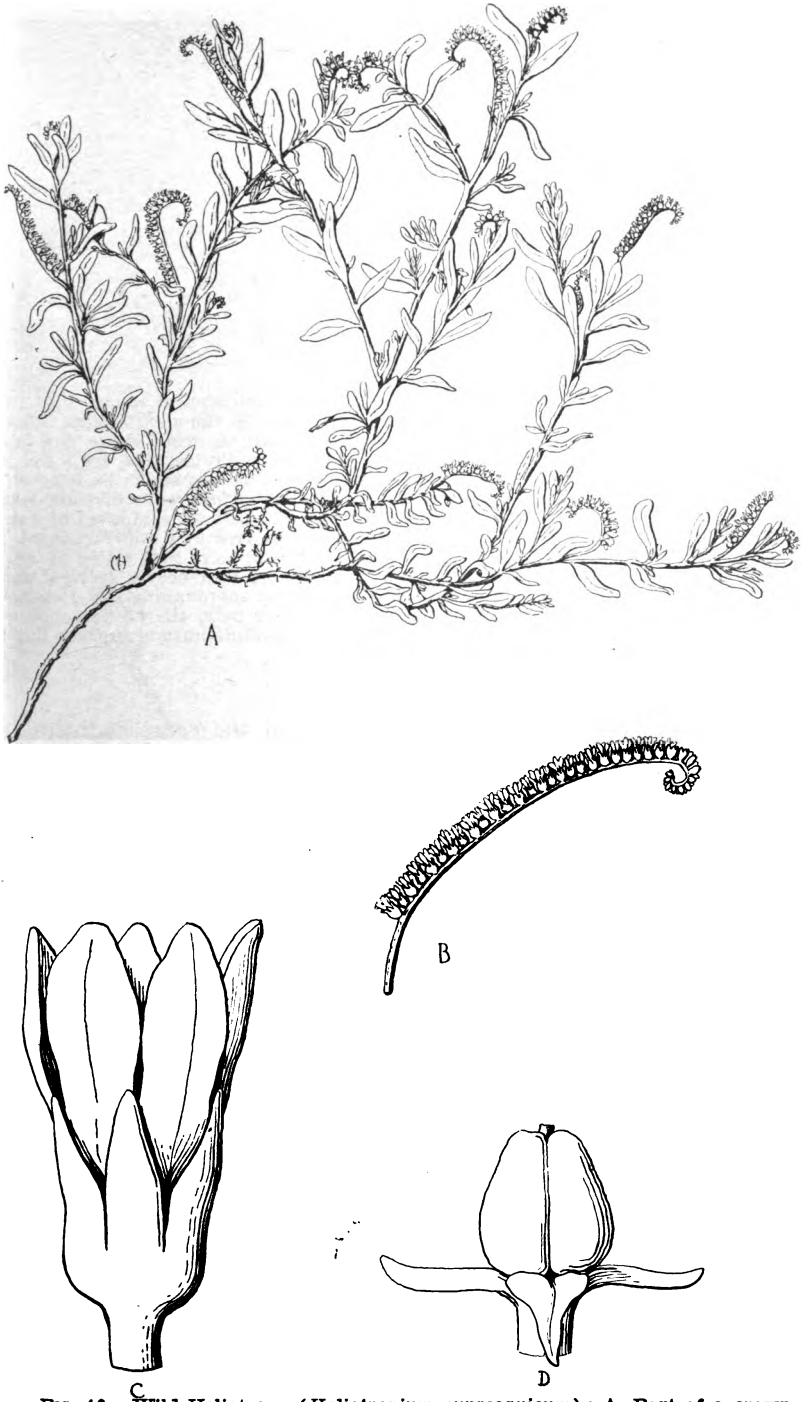

FIG. 46. Wild Heliotrope (*Heliotropium curassavicum*): A, Part of a crown bearing the thick, pale green leaves and one-sided spikes of flowers, x 1. B, Single spike, x 2. C, Single flower, x 20. D, Immature fruit showing the lobed appearance, x 20.

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HEDGE NETTLE.

(*Stachys bullata* Benth.)

English name: (1) Hedge Nettle.

DESCRIPTION.

Habit: Annual or perennial herb with simple, erect, unbranched stems, 1 to 2 feet high, square in cross-section and rough hairy, especially on the stem angles. *Leaves* gray-green, opposite, 1 to 3 inches long and about half as wide above the broad, squarish base, narrowing upward to the rounded tip, with margins scalloped and surfaces densely covered with soft hairs. Lower leaves on leaf-stalks as long as the blades, the upper leaf-stalks shorter or nearly absent. *Flowers* in distinct whorls at the top of the stems, usually about 6 in a whorl. Each flower composed of a calyx of 5 sepals united for over half their length, their tips free and stiffly pointed, the calyx persisting about the ripening fruit; corolla purplish, more than twice as long as the calyx, prominently 2-lipped with the lower 3-lobed lip bent nearly at right angles to the tube and bearing on its inner surface a hairy ring surrounding the 4 stamens; stamens unequal, 2 with longer filaments than the other pair, all the filaments with spreading bristly hairs; ovary becoming divided into 4 blunt nutlets surrounding the base of the single long style.

DISTRIBUTION.

Common along roadsides in the hills of all the coast counties and showing considerable variation in amount of hairiness and size and shape of the leaves depending upon the location; plants found along shaded paths or creek beds with larger leaves and diminished pubescence. Reproducing by seed and by creeping stems from which large colonies of the plant may develop. Flowering in late spring, March to May, seed ripening in June.

CONTROL.

The Hedge Nettle is rarely a nuisance and is easily controlled by mowing once or twice in the season.

The genus includes about a half-dozen species more or less common in California and all called Hedge Nettles. The above described species, common along the Californian Coast, gives way in the interior to *S. ajugoides* Bentham, which is the more familiar species of the Great Valley, growing along streams or in low-lying pastures. It may be readily known from the Coast Hedge Nettle described above by its white flowers.

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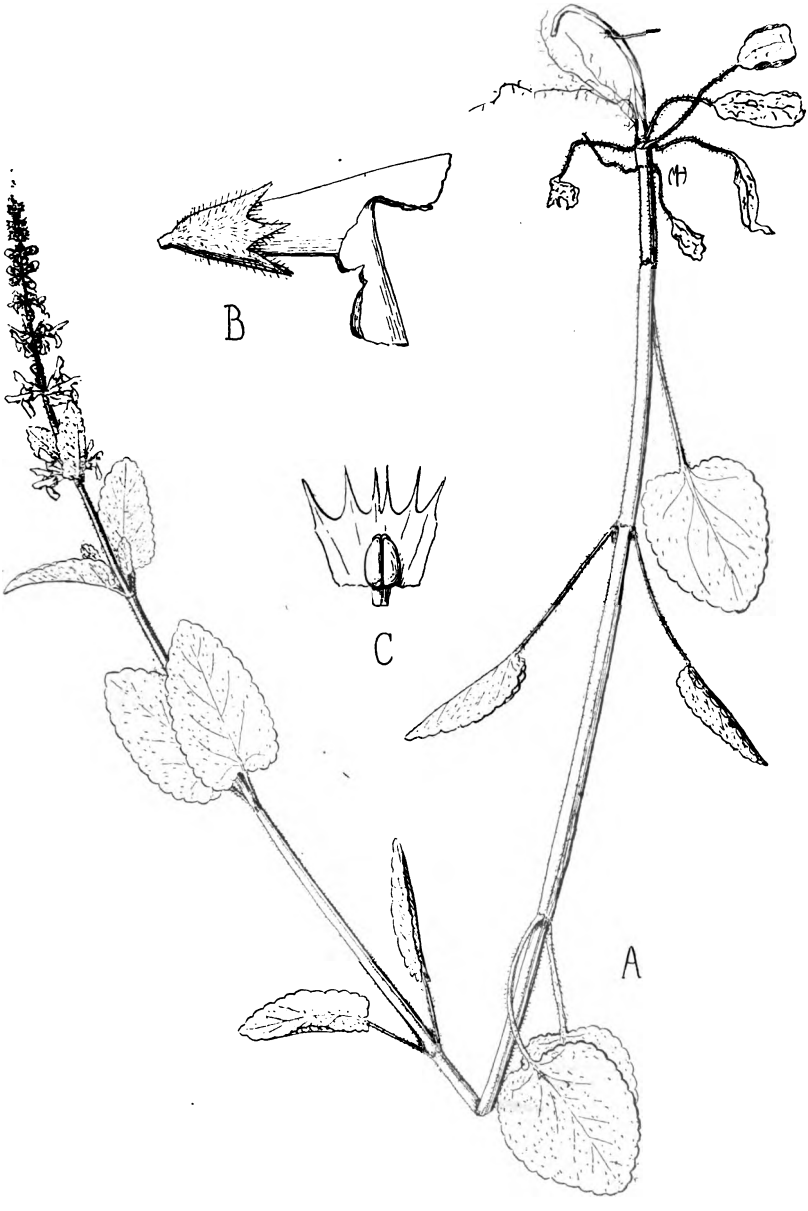

FIG. 47. Hedge Nettle (*Stachys bullata*): A, Habit of plant. B, Corolla and calyx in lateral view, enlarged. C, Fruiting calyx expanded to show the 4 included nutlets.

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CREEK MILKWEED.

(*Asclepias speciosa* Torrey.)

English name: (1) Creek Milkweed.

DESCRIPTION.

Habit: Perennial herb, with milky juice, having stout, erect stems, 2 to 4 feet high, rising from thick, spreading, deep-seated roots and bearing large, thick, opposite leaves, oval-pointed or oblong, 4 to 5 inches long and 1.5 to 2 inches wide, prominently veined, on short leaf-stalks less than ½ inch long. Both stems and leaves covered with dense, soft, woolly hairs which may more or less disappear on old plants. *Flowers* pink or purple, grouped in umbels at the tops of the stems or terminating lateral branches in the axils of the upper leaves. Each flower perfect, regular, composed of 5 sepals and as many petals and stamens, the latter joined by their filaments to a tube which is attached to a central, cylindrical column formed by the enlarged and united tips of the 2 styles. Stamen-tube bearing hoods from each of which protrudes a curving horn. *Ovaries* 2, free from each other, ripening to a pair of dry, silky capsules (follicles) containing many flattened, light brown seeds, each of the latter with a tuft of long hairs at one end.

DISTRIBUTION.

The milkweeds constitute a group of weeds having special significance to stockmen since the milky juice is poisonous to horses, cattle, and sheep. The number of milkweeds growing in California is about six, all but the Narrow-leaf Milkweed (*A. mexicana* Cavanilles), similar to the Creek Milkweed in habit and mostly found growing upon the dry hills or along roadsides. *A. mexicana* has narrow, green, smooth leaves grouped in whorls of 3 to 6; it is perhaps the most dangerous of the milkweeds since more apt to be eaten than the white, woolly kinds.

CONTROL.

Stock appear to eat milkweeds only when other forage is scarce and probably little damage results from the growth of these plants except on overstocked ranges or pastures or while animals are being driven along roads. Protection is assured by first cutting down the plants before stock are permitted to graze.

Key to the Common Species of Asclepias.

Hoods of the stamens without horns.
  Leaves and stems smooth, green_____(1) Purple Milkweed (*A. cordifolia*)
  Leaves and stems white-woolly_____(2) California Milkweed (*A. californica*)
Hoods of the stamens including a horn or crest.
  Leaves and stems white-woolly; leaves broad and flat.
    Leaves in pairs and opposite each other; corolla purplish.
      Lateral umbels long-stalked_____(3) Creek Milkweed (*A. speciosa*)
      Lateral umbels very short-stalked____(4) Woolly Milkweed (*A. vestita*)
    Some of the leaves in whorls; corolla creamy-white_____
    _____(5) Hoary Milkweed (*A. eriocarpa*)
  Leaves and stems smooth, green; leaves narrow, sickle-shaped and folded along the midribs; always in whorls of 3 or more_____
  _____(6) Narrow-leaf Milkweed (*A. mexicana*)

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FIG. 48. Creek Milkweed (*Asclepias speciosa*): A, B, E, Habit, seed capsules, and seed of *A. speciosa*. C, Umbel of *A. eriocarpa* showing flowers and young capsules. D, section of a stem of *A. mexicana*.

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RIBWORT.

(*Plantago lanceolata* L.)

English names: (1) Ribwort; (2) Rib-grass; (3) English Plantain; (4) Snake Plantain.

DESCRIPTION.

Habit: Herbaceous perennial bearing dark green, somewhat hairy leaves, densely clustered at the top of the short, thick rootstock and surrounding the erect, naked, flower-bearing stems. *Leaves* erect or spreading, 3 to 12 inches long and up to an inch in width, entire, gradually diminished upward to pointed tips and tapering below to slender, grooved leaf-stalks with their bases surrounded by brownish hairs; blades strongly 3 to 5-ribbed. Flowering stems (scapes) longer than the leaves, often twice as long, angled and grooved, and terminated by dense, cylindrical spikes, ½ to 2 inches long; each spike at first short and thick but becoming elongated and slender. *Flowers* complete; the calyx of 4 broad sepals with narrow, green mid-ribs and papery margins, the 2 lower sepals often united; corolla of 4 petals joined below to a short tube but flaring above by a flat top formed of the free pointed tips and surrounding the 4 long, protruding stamens and central ovary. *Ovary* ripening to a 2-seeded capsule that breaks around its middle to free the numerous, small, concave seeds, which become sticky when their seed-coats are moistened.

DISTRIBUTION.

Besides the two introduced species, which are the common weeds, there is another plantain, a native plant which deserves notice; this is a small, soft-silky annual, scarcely rising six inches high but so abundant throughout the warmer parts of the state as to become an important factor in the forage value of many ranges and hillside pastures. These three plantains may be distinguished as follows:

Key to the Weedy Plantains.

Perennials without silky, hairy coating to stems and leaves, growing in low, moist ground; spikes more than ½ inch long.
Leaves lanceolate; spikes 1 to 2 inches long; capsule 2-seeded.(1) *P. lanceolata*
Leaves broader (ovate); spikes 3 to 8 inches long; capsule 4 to 16-seeded.....(2) *P. major*
Annual soft-silky weed of dry plains and hillsides with short, thick spikes, ½ inch or less long.....(3) *P. patagonica* var. *californica*

CONTROL.

Plantains are often difficult to eradicate when once well established. Ribwort and Common Plantain (*P. major*) have short but thick rootstocks which can quickly develop new herbage after their tops have been cut off, hence hand-cutting or hoeing must go deep enough to ensure the removal of the thickened crowns. Plantains seed well; badly infested land should be plowed early to prevent seed maturing and preferably cropped with some tilled crop for a year or two. The native weed is practically immune against grazing animals because of its bitter taste and therefore tends to become more and more abundant, especially on over-grazed ranges. Most of the land where it grows is never plowed but it will repay stockmen at least to keep this native pest in check by plowing patches of the weed as late in spring as possible and so giving a chance to the summer sun to aid in the work.

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FIG. 49. Ribwort (*Plantago lanceolata*): A, Habit of ribwort. B, Habit of Common Plantain.

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COMMON SPIKEWEED.

(*Hemizonia pungens* Torrey and Gray)

English names: (1) Common Spikeweed; (2) Prickly Tarweed.

DESCRIPTION.

Habit: Annual, rigidly and freely branching herb, 1 to 3 or even 5 feet in height, the stems more or less covered with spreading, stiff hairs, some of which are glandular and contain a sweet scented secretion. *Lower leaves* 1 to 3 inches long, deeply lobed, the lobes ending in minute, sharp spines; upper leaves entire, needlelike, ½ inch or less long, the majority borne in dense, globular clusters on short branches in the axils of the longer, spiny leaves; leaves more or less deep green, glandular and scented. *Flowers*, yellow, grouped in small heads, ½ inch or less broad, at or near the ends of the stem branches and usually in the center of a cluster of rather long leaves, each head enclosed at base by an involucre composed of a single series of narrow, pointed, involucral bracts. Flowers both ray and disk. Ray-flowers 25 to 40, with small strap-shaped corollas deeply cleft at the tips and surmounting the fertile, thick ovaries which ripen to one-seeded, roughened, dry fruits (achenes), each half enveloped by an involucral bract. *Ovaries* of the disk flowers sterile.

DISTRIBUTION.

Abundant in southern California and northward through the San Joaquin Valley to the Bay Region. Favors land more or less alkaline and toward the southern end of the San Joaquin Valley in places forms nearly the exclusive vegetation on land heavily impregnated with white alkali.

CONTROL.

Where this weed becomes a serious nuisance the land is often too alkaline for cultivation and of value mainly as range land. Pasturing to sheep before the stems have become too dry and woody has been shown to be an effective means of eradication.

The Spikeweed occurs in a number of forms, differing in the amount of hairiness and also in the size of the leaves. It is of interest to note that Spikeweed is not merely an undesirable factor in the vegetation wherever found, since in the southern part of the state it is highly valued as bee forage. Closely allied to the Common Spikeweed but readily distinguished by its heavy, ill-scented odor and dark green herbage is Fitch's Spikeweed (*Hemizonia fitchii* Gray), a native of the Sacramento-San Joaquin Valley and now becoming established as a weed in southern California.

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FIG. 50. Common Spikeweed (*Hemizonia pungens*) : A, Habit of *H. pungens*, showing mature, flowering plant. B, Head of same enlarged. C, Seeding plant. D, Portion of a plant of *H. pungens* var. *interior*, showing the reduced, more spinescent foliage characteristic of this variety.

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TARWEED.

(*Madia elegans* Don.)

English names: (1) Tarweed; (2) Common Madia.

DESCRIPTION.

Habit: Annual or, less often, perennial herb, 1 to 4 feet high, the stout stems branching above, sticky with glandular hairs and heavy scented. *Leaves* strap-shaped, mostly alternate, 3 to 8 inches long, with entire or toothed margins, densely hairy with short hairs some of which are glandular; upper leaves much reduced in size. *Flowers* in heads, each head terminating one of the nearly leafless stem branches; flowers yellow, opening in the evening and closing the following morning. Each head enclosed at base by an involucre composed of a single series of green bracts, each of which is closely folded about the ovary of a ray-flower. Ray-flowers about a dozen, their strap-shaped corollas bright yellow, deeply 3-lobed at the summit, sometimes with a red spot at base. Disk flowers small, few to many, their ovaries usually infertile, the plant developing its seed only in the flattened one-seeded dry fruits (achenes) of the ray-flowers. Pappus none. When the fruits are mature, they drop away from the head, each achene enclosed in its bract.

DISTRIBUTION.

Common weed of dry hills and valley fields from Oregon to Lower California, occurring in a number of forms, differing in the disposition of the leaves, varying amount of the glandular hairs, etc., but not easily distinguished.

Other Tarweeds occur in locations similar to the places favored by the Common Madia. All are native species except the Chile Tarweed (*M. sativa* Molina), which may be distinguished from the plant described above by its rays less than half the length of those of the Common Madia and its heads on very short stalks (peduncles) or the stalks practically absent as contrasted with the long, naked stalks bearing the heads of *M. elegans*. The Chile Tarweed has become abundant in waste lots and fields about San Francisco Bay and is also found at various stations to the south as far as San Diego.

CONTROL.

Where Tarweeds become a source of trouble, as on waste lots or in neglected corners, they should be mowed before maturity and the herbage burned.

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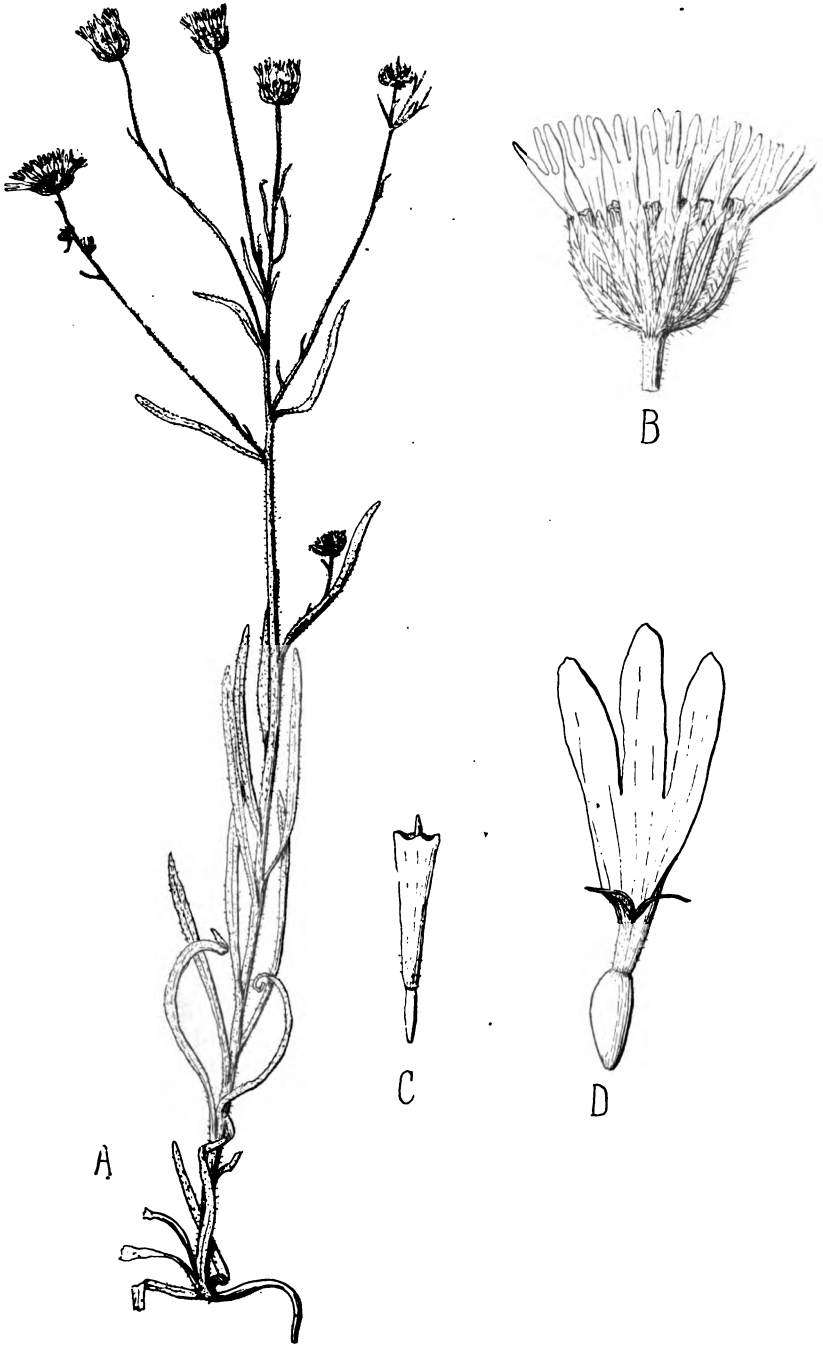

FIG. 51. Tarweed (*Madia elegans*): A, Habit of plant. B, Head enlarged, showing the single series of involucral bracts and the 3-lobed ray corollas. C, Disk flower with its infertile ovary. D, Ray flower showing the swollen, fertile ovary.

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BULL THISTLE.

(*Cirsium lanceolatum* [Linn.] Hill)

English names: (1) Bull Thistle; (2) Spear Thistle; (3) Plume Thistle; (4) Bur Thistle; (5) Common Thistle.

DESCRIPTION.

Habit: Perennial herb with stout, branching, striate stems, 2 to 4 feet high and more or less woolly, bearing numerous leaves, which are green and roughened above, lighter and somewhat hairy below, the prominent midrib conspicuously hairy on the younger leaves. *Leaf-blades* coarsely toothed or deeply lobed nearly to the midrib, the tips of the teeth or lobes armed with sharp, stout, yellow prickles and the leaf margins elsewhere bristly. *Lower leaves* 6 inches to 1 foot in length, 2.5 to 4 inches wide, attached to stems by leaf-stalks; the upper attached by the bases of the blades which are more or less continued down the stems (decurrent) as interrupted bristly wings. *Flowers* dark purple, fragrant, occurring in large-sized heads, 1.5 to 2 inches high and nearly as broad, in clusters of 4 or 5 at the summits of the stems. Each head enclosed at base in an involucre composed of numerous, slender, overlapping bracts arranged in many series, the bracts ending in long, spreading, needle-like tips, the involucres appearing at first slightly cobwebby due to white hairs developed between the bracts. Flowers very numerous, all alike, each with a long, slender corolla-tube enlarging above and bearing the 5 slender, free tips to the petals. *Ovaries* fertile, developing into dry, 1-seeded, oblong fruits (achenes), somewhat flattened, surmounted by numerous soft, white, plumose, pappus bristles which are united at base and fall away from the mature fruit together.

DISTRIBUTION.

Naturalized weed, native of Europe and Asia but now introduced into all parts of the world and often a most serious nuisance in pastures, fields, or in neglected places—waste lots, fence corners, etc. In California distributed from the San Francisco Bay region eastward and northward to Stockton in San Joaquin County; Ione, Amador County; Plumas County; Siskiyou County. Also becoming naturalized on the north coast at Eureka. Not reported as yet from southern part of the state.

CONTROL.

Eradication of the Common or Bull Thistle must take account of its perennial habit. The first year's growth produces a rosette of basal leaves, the flowering stem growing in the second season. The thick crown readily sends up one or more stems if the first be cut away, hence in cutting the plant, care should be taken to grub it out below the crown. Where these thistles have gained headway and formed colonies, eradication is best brought about by mowing and burning the herbage upon the spot before the large heads have had time to develop the hundreds of seeds produced by the numerous flowers.

OTHER NATIVE THISTLES.

Two native thistles occur in California commonly enough to perhaps justify mention. *Cirsium edule* Nuttall (called Edible Thistle since its stems are reported to have been eaten by the Indian tribes of what is now the state of Oregon) is common in the Coast district from San Francisco northward along creek bottoms and is reported from southern California—San Bernardino, Pasadena, Santa Barbara; it may be distinguished from the Common Thistle by its heads surrounded by a

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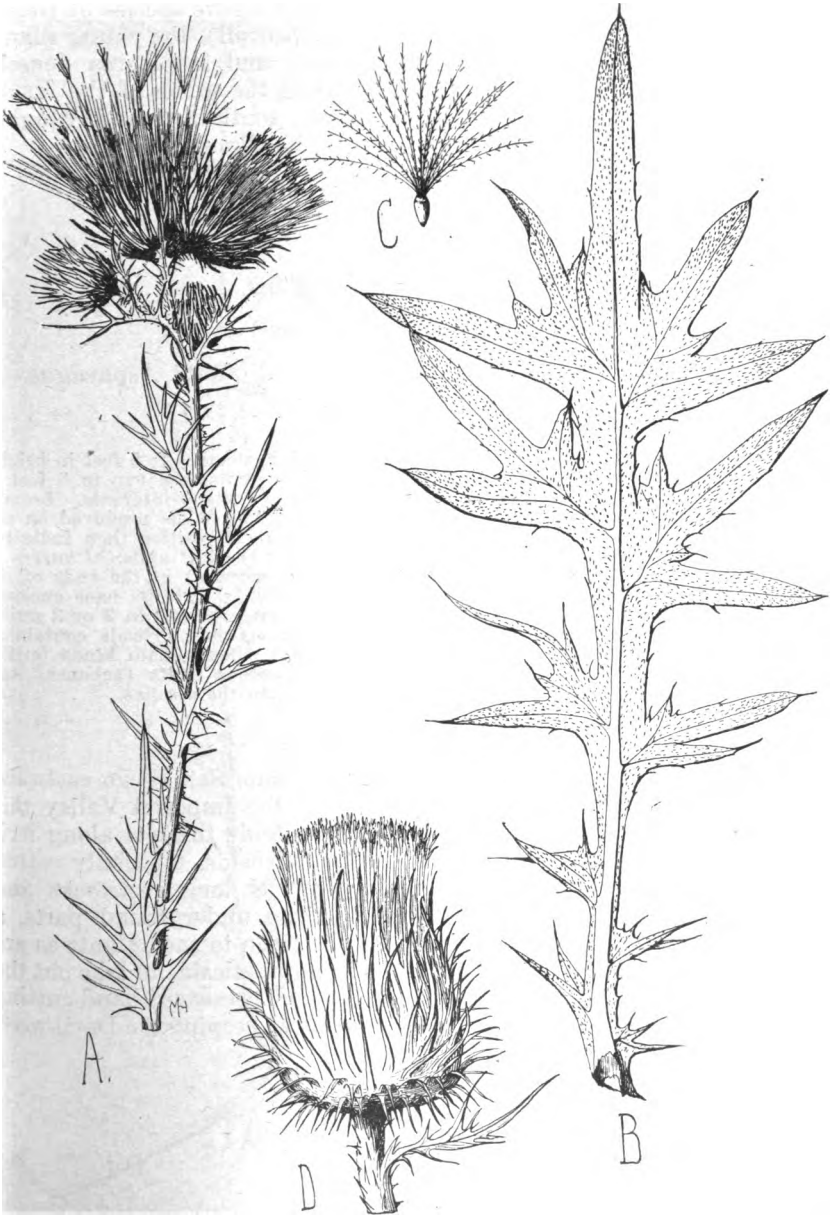

FIG. 52. Bull Thistle (*Cirsium lanceolatum*): A, Segment of stem showing the upper leaves and cluster of heads. B, Lower leaf. C, Fruit. D, Head showing the pointed bracts.

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leafy whorl and the stems without the decurrent wings; it is usually a taller plant than the Bull Thistle. The other native species of weedy habit is the Western Thistle (*C. occidentalis* Nuttall), the young plants white woolly with thick cottony pubescence and involucres densely enveloped by cobwebby hairs almost concealing the spines of the fracts, grows along the coast from San Francisco southward and ranging inland in southern California to the San Bernardinos.

MEXICAN DEVIL-WEED.

(*Aster spinosus* Bentham.)

English names: (1) Mexican Devil-weed; (2) Wild Asparagus.

DESCRIPTION.

Habit: Herbaceous perennial with numerous ascending stems, ½ to 5 feet in height, smooth and glabrous, and widely spreading underground rootstocks (up to 5 feet in length), giving rise to aerial shoots and bunches of fibrous roots at intervals. *Leaves*, green, few, small and narrow, ¾ to 2 inches long and ¼ inch wide, produced on the lower parts of the stems only and soon falling away, their position then indicated by the sharp, stiff spines, ¼ to ½ inch long, developed in the leaf axils. *Flowers* in heads which are solitary or grouped in loose clusters (racemes) at the ends of the reedy stems. Each head about ½ inch broad and nearly as high, its base enclosed by an involucre formed of narrow, pointed, unequal bracts arranged in 2 or 3 series, each bract brownish or greenish with narrow, papery margins. Heads containing both white ray flowers and yellowish or brownish disk flowers, both kinds fertile, their minute ovaries developing into dry, 1-seeded, glabrous fruits (achenes) surmounted by numerous straight hairs (pappus) longer than the corollas.

DISTRIBUTION.

Native of the Mexican region and ranging from San Diego eastward to Texas and south to Central America. In the Imperial Valley this is one of the worst weeds, often forming veritable thickets along irrigating ditches and thence infesting cultivated fields, especially cotton and alfalfa. The weed spreads mainly by its long rootstocks and eradication must include the removal of these underground parts, a none too easy task. Especial care should be given to such plants as are found on ditch banks; here it may often be impracticable to take out the rootstocks for fear of weakening the levees and persistent hand-cutting of the shoots as they appear is the only means of keeping the Devil-weed within bounds.

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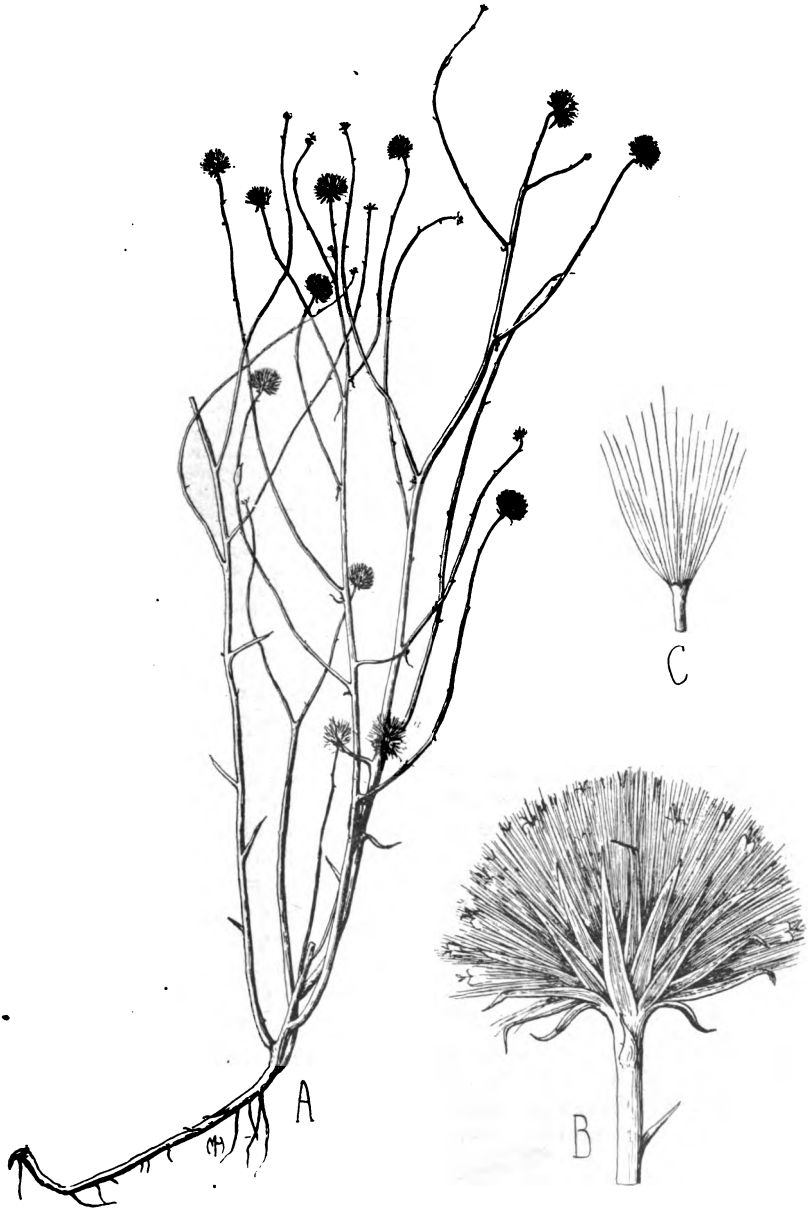

FIG. 53. Mexican Devil-weed (*Aster spinosus*): Habit of plant developed at the tip of one of the root-stocks. B, Head enlarged, showing the involucre of pointed bracts and small flowers nearly hidden by the abundant yellowish pappus.

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SPINY SOW THISTLE.

(*Sonchus asper* [Linn.] Hill)

English names: (1) Spiny Sow Thistle; (2) Prickly Sow Thistle.

DESCRIPTION.

Habit: Annual herb with smooth, usually simple stems, 1 to 4 or, less often, even 6 to 7 feet in height, bearing alternate clasping leaves, 2 to 8 inches long by 1 to 2 inches wide, lower leaves broader above the middle and tapering to a leaf-stalk, the blades lobed or coarsely toothed; upper leaves attached to the stems by the broad bases of the blades, entire; all of the leaves with smooth surfaces, prominently veined, their margins armed with sharp, spiny teeth. *Flowers* yellow, occurring in numerous heads at the summits of the stems, the stalk of each head more or less viscid with glandular, spreading hairs. Each head ½ to ¾ inch in diameter, its enlarged base enclosed by an involucre composed of numerous, small, pointed bracts arranged in 3 or 4 overlapping series and a single series of longer erect bracts. Flowers all alike, their strap-shaped corollas 5-toothed at the squarish tips. Style branches slender. Fruit 1-seeded, dry (achene), more or less flattened and the margins bordered with a narrow wing, longitudinally ribbed with about 3 ribs on each side, both wings and ribs rough. *Fruit* surmounted by a crown of many soft, fine, white bristles (pappus) connected together at base and falling away together.

DISTRIBUTION.

The Spiny Sow Thistle is a native of Europe but is now introduced into all parts of the world along with its more common ally, *Sonchus oleraceus* (Common Sow Thistle). Both plants are familiar weeds of the dooryard and are rarely absent from neglected lots, poorly tilled fields, or from the weedy fringe that all too often borders the country roads. Both species grow only in good soil and where moisture is abundant. These weeds are not always easily distinguished, but may be told apart by the lack of the glandular hairs on the stalks supporting the heads in *S. oleraceus*; in this species also, the achenes are not merely ribbed lengthwise but are wrinkled cross-wise, whereas in the plant figured the intervals between the ribs are smooth.

CONTROL.

These large succulent weeds are best kept within bounds by cutting off the tops with the hoe before the numerous seeds are matured; where these and other weeds of similar habit are growing in large patches, they may be mown and the herbage burned.

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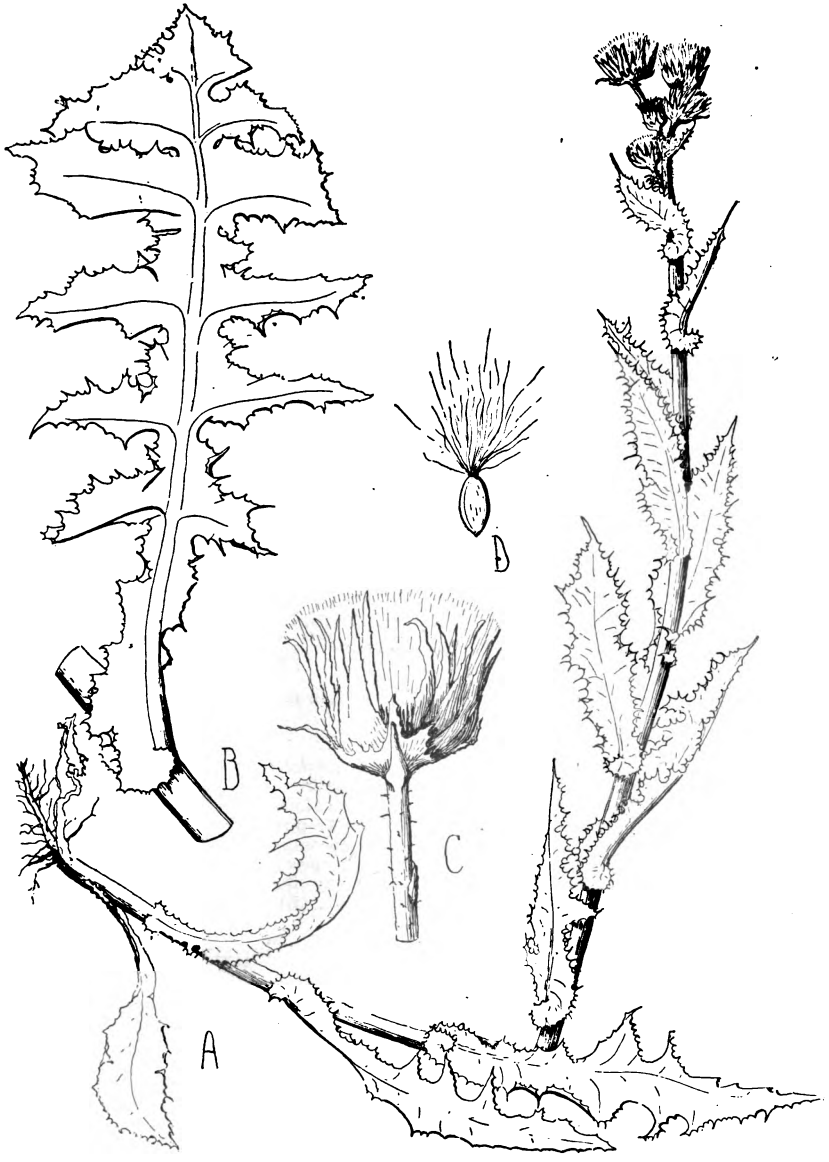

FIG. 54. Spiny Sow Thistle (*Sonchus asper*): A, Habit of plant showing leaf variation and cluster of heads. B, Lower leaf showing the deeply lobed blade (pinnatifid blade). C, Head enlarged about one-fourth. D, Fruit showing shape and terminal pappus.

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YELLOW STAR THISTLE.

(*Centaurea solstitialis* Linn.)

English names: (1) Yellow Star Thistle; (2) St. Barnaby's Thistle.

DESCRIPTION.

Habit: Annual herb with rigid, spreading stems branched from the base and more or less whitened with a loose, cottony wool, 1 to 2.5 feet high, conspicuously winged by the long, decurrent bases of the alternate leaves. *Basal leaves* spreading, 2 to 3 inches long, very deeply lobed (pinnatifid), the terminal lobe the largest; upper leaves, narrow, entire and sharply pointed, ½ to 1 inch in length; all the leaves more or less whitened as the stems. *Flowers* in heads, solitary at the ends of the branches, the heads roundish, an inch high, enclosed at base in an urn-shaped involucre composed of numerous, broad, stiff bracts arranged in 4 or 5 series, the lowest terminated by a 3-pronged short spine, the middle bracts armed with simple, stout, yellow and spreading spines, ¼ to 1 inch long, upper bracts unarmed. Flowers bright yellow, all alike with tubular corollas, the outer flowers of the head somewhat larger than the central ones; ovaries becoming light-colored, smooth and shining, 1-seeded, dry fruits (achenes) surmounted by numerous slender, white and soft bristles (pappus), 3 to 4 times as long as the body of the achene.

DISTRIBUTION.

The Star Thistles include a number of the worst weeds with which the Californian landowner has to contend, whether the land be a city lot or a larger tract. All are European immigrants, for the most part distributed as impurities in seed. The plant genus *Centaurea* numbers some 350 species but of this number only about five have become weeds within California though in the eastern states at least twice as many species are justly regarded with disapproval. The following key will serve to distinguish the Californian kinds:

Key to the Weedy Centaureas.

Bracts of the involucre spiny.
  Flowers yellow.
    Spines stout, ½ to 1 inch long------(1) *C. solstitialis* (Yellow Star Thistle)
    Spines weak, ⅛ to ⅓ inch long----(2) *C. melitensis* (Napa Thistle, Tocalote)
  Flowers blue or purple----------(3) *C. calcitrapa* (Purple Star Thistle)
Bracts of the involucre, not spiny; flowers blue or purple.
  Marginal flowers of the head much enlarged compared to the central flowers; flowers deep blue----------(4) *C. cyanus* (Bluebottle; Cornflower)
  Marginal flowers only slightly enlarged, not ray-like; flowers purple--------
  ----------(5) *C. salmantica* (Escobilla)

The first two species in California are most important as weeds of grain fields, Tocalote especially obnoxious in the Sacramento Valley. Bluebottle or Corn-flower, frequently grown as an ornamental, has established itself as an undesirable immigrant in southern California (Orange County).

CONTROL.

Measures to keep the Star Thistle in check should be directed at preventing their spread both by denying established plants the possibility of maturing their seeds and by rigid exclusion of new immigrants in the form of seed impurity. Unfortunately the achenes of the Yellow Star Thistle are not infrequently found in alfalfa seed, while wheat and barley seed grain are apt to carry the fruits of Tocalote.

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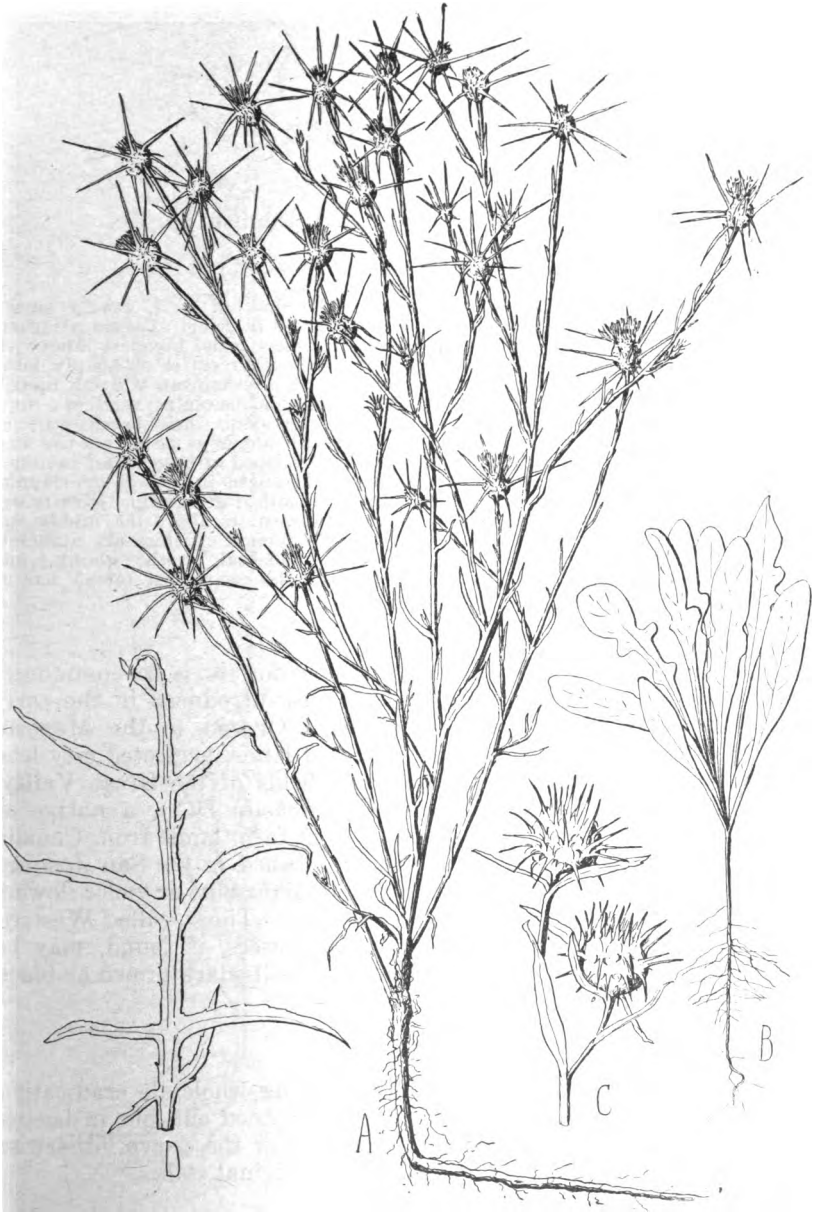

FIG. 55. Yellow Star Thistle (*Centaurea solstitialis*): A, Habit of *Centaurea solstitialis*; note the stiff, widely spreading, involucral spines. B, Seedling state of *Centaurea militensis* (Tocalote). C, Heads of Tocalote. D, Leaf of *Centaurea calcitrapa*.

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PRICKLY LETTUCE.

(*Lactuca scariola* L.)

English names: (1) Prickly Lettuce; (2) English Thistle.

DESCRIPTION.

Habit: Annual or biennial herb with erect and somewhat rigid, nearly smooth stems, 2 to 6 feet high, branching above and bluish-green in color. *Leaves* alternate, green; the lower 4 to 8 inches long and 1 to 2 inches wide, broadest above the middle, terminated bluntly or with an acute tip, and either entire or deeply lobed, their margins more or less prickly and undersides of the prominent, whitish midribs beset with curved prickles, blades twisted at the base and becoming vertical; upper leaves smaller, generally entire, tightly clasping the stem, their bases auricled. *Flowers* cream-yellow, all alike and occurring in small numerous heads on the stem branches, each head containing 8 to 15 flowers and enveloped at base by an involucre of narrow, pointed, green bracts of varying length arranged in 2 to 3 overlapping series. The strap-shaped free ends to the corollas 5-toothed at the tip. *Fruits* dry, 1-seeded (achenes), prominently ribbed, enlarging upward to above the middle and then abruptly contracting to a thread-like beak, at the summit of which are numerous soft, white, straight hairs (pappus); body of achene and beak together about ½ inch long. The variety *integrata* (in California perhaps the commonest form) has all the leaves practically entire.

DISTRIBUTION.

The common wild lettuce, with cream-yellow flowers, is the commonest species of the genus within the state and was introduced in the early days of the settlement. It is found from Oregon to the Mexican boundary, growing along roadsides, in vacant lands, neglected city lots. It has become a serious pest in the grain fields of the Great Valley. Other lettuces occur: Blue Lettuce (*L. pulchella* DC.), a native of eastern North America and a troublemaker in farm lands from Canada to the lower Mississippi Valley, is now established in the San Joaquin Valley and in Modoc and Lassen counties; its light blue or violet flowers at once distinguish it from the Prickly Lettuce. The so-called Western Lettuce (*L. ludoviciana* DC.), with yellow flowers, if found, may be distinguished from our most common species by its dark brown or black achenes, which are light colored in *L. scariola*.

CONTROL.

These weeds commonly grow isolated, making wholesale eradication by plowing impracticable. They are generally hoed out, but in hoeing care must be taken to cut them off a little below the crown, otherwise several stems quickly grow up to replace the original stalk.

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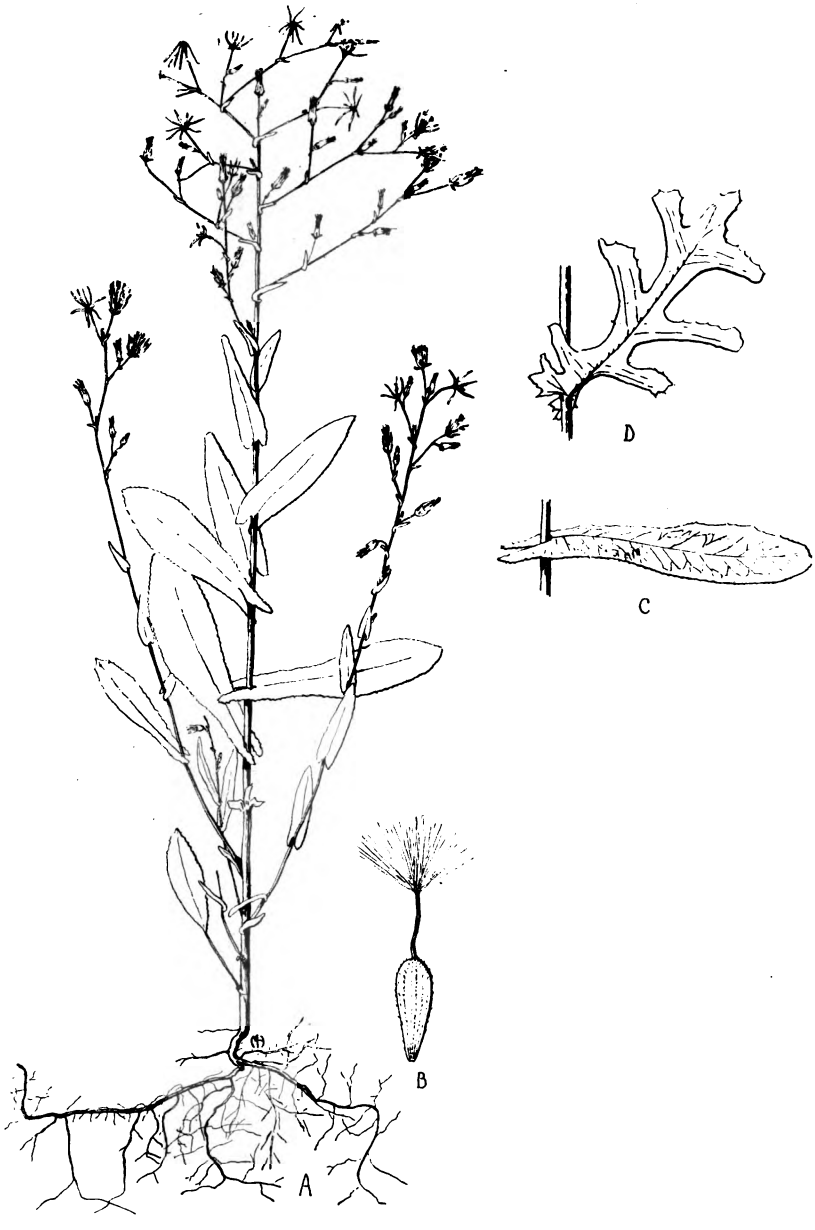

FIG. 56. Prickly Lettuce (*Lactuca scariola*): A, Habit of var. *integrata*. B, Achene showing beak and pappus tuft at end. C, Leaf of var. *integrata*. D, Leaf of typical form, showing its deeply lobed character.

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COMMON SUNFLOWER.

(*Helianthus annuus* Linn.)

English name: (1) Common Sunflower.

DESCRIPTION.

Habit: Stout, coarse, annual herb with erect or more often branching stems, 2 to 8 feet high, roughened and frequently blotched with brownish spots. *Leaves* pointed, deep green in color, variable in size and shape, all with leaf-stalks; lower leaves opposite, often large, 3 to 12 inches long and two-thirds as wide, wedge-shaped above the more or less heart-shaped base, distinctly 3-nerved with the veins projecting on the underside, rough on both sides, with margins coarsely toothed; upper leaves alternate, smaller and narrower, on shorter leaf-stalks or these failing, the margins slightly toothed or entire. *Flowers* in large heads, 2 to 4 inches across, solitary at the ends of the bristly-hairy branches, or 2 to 3 clustered together, their bases enclosed in an involucre composed of numerous green, long-pointed, leafy bracts overlapping one another, their margins bristly. Flowers of two sorts: bright yellow ray flowers with strap-shaped corollas and having neither stamens nor styles, their ovaries rudimentary, and numerous brownish or purplish disk-flowers, which are perfect, their ovaries ripening to thick, 4-sided, dry, 1-seeded fruits (achenes), enlarging from their bases, each with a pointed, purplish-tipped scale partially enclosing it. *Fruit* surmounted for a time by a pappus composed of pointed, stiff scales at the angles of the fruit with some smaller scales between.

DISTRIBUTION.

The Common Sunflower, a plant so familiar that description is almost superfluous, is a native of eastern North America, now established on the Pacific Coast from Washington to Lower California. Other sunflowers, occurring in the state and locally more or less abundant, may be distinguished from the Common Sunflower by the following key:

Key to the Weedy Sunflowers.

Annual species, with flattened, brown or purple centers to the heads.
- Bracts of the involucre with broad bases and terminated by narrow, pointed tips ---------- (1) *H. annuus*
- Bracts of the involucre narrow and tapering gradually to slender tips.
  - Tips of the scales of the disk-florets not longer than the florets.. (2) *H. exilis*
  - Tips of the scales of the disk-florets longer than the florets.. (3) *H. bolanderi*

Perennial species, with yellowish, rounded centers to the heads.
- Scales of the pappus narrowly long-pointed ---------- (4) *H. parishii*
- Scales of the pappus broadly tapering ---------- (5) *H. californicus*

Of these species, the second is common in the Sacramento Valley and some of the valleys of the Coast Range (Clear Lake); the third is abundant in the delta region from Sacramento to Stockton, infesting grain-fields and flowering in late summer; *H. parishii* is a species of southern California, growing in wet lands about Los Angeles and eastward to San Bernardino at least; the last species, *H. californicus*, is wide-spread in the state, especially along streams and may be a source of trouble in pasture land.

CONTROL.

Sunflowers are among the commonest invaders of neglected farm lands or overflow lands but readily yield to simple cultivation, their roots being easily pulled from the soil. This slight hold upon the ground also permits hand pulling, a practical method of eradication where the weeds are growing in fence corners, kitchen gardens, or similar places.

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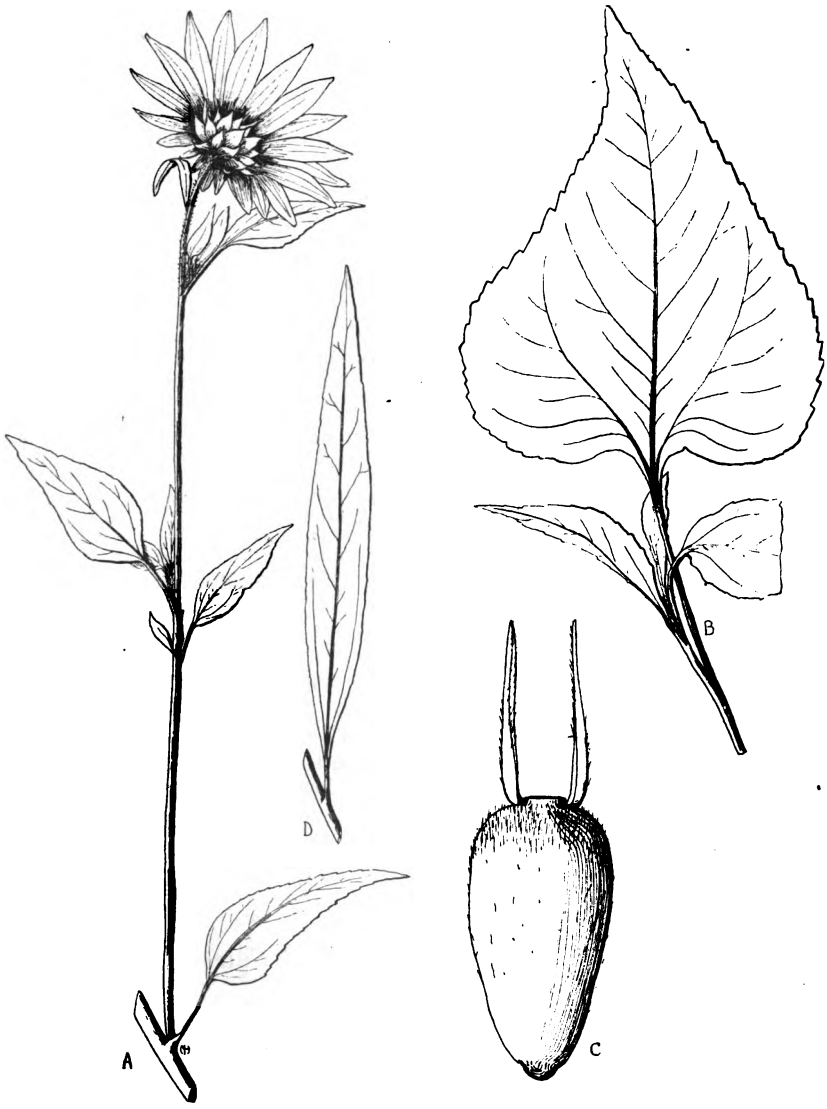

FIG. 57. Common Sunflower (*Helianthus annuus*): A, Branch showing character of the upper leaves and involucre below the long, yellow rays. B, Leaf of stem showing venation and heart-shaped base. C, Achene. D, Stem leaf of *H. californicus*.

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BRISTLY OX-TONGUE.

(*Picris echioides* L.)

English names: (1) Bristly Ox-tongue; (2) Bugloss; (3) Bugloss Picris.

DESCRIPTION.

Habit: Biennial herb with angled, prickly stems, 2 to 3 feet high, branching from the base upwards. Basal and lower leaves large, 2 to 6 inches long, ½ to 1.5 inches wide, broadening from the margined stalk outward to above the middle and then contracting to the blunt end, the margin shallowly scalloped; upper leaves smaller, not narrowed at base, clasping the stem; all the leaves alternate, rough-hairy, especially on the undersides of the midribs. *Flowers* in heads, about ½ inch broad, grouped in open clusters of three or four near the tops of the stems or solitary. Each head enclosed at base by an involucre composed of 4 to 5 large, green, bristly outer bracts, with broad bases and long, pointed tips, and about an equal number of narrower, long, pointed, densely bristly inner bracts, which are prominently keeled. Flowers of a head all alike, with strap-shaped, yellow corollas, their ovaries developing into small, light red-brown, dry, 1-seeded fruits (achenes), with surfaces ridged cross-wise, and tipped by beaks as long or longer than the body of the achene. Beaks surmounted by the pappus, composed of white, branching hairs, united by their bases into a ring and becoming detached from the ripe achene.

DISTRIBUTION.

This plant is well established in the bay region of Central California, growing in fields and vacant lots and enjoying comparative immunity from grazing animals because of its bitter, acrid juice. It is steadily enlarging its area and in 1910 was collected in southern California at Cienaga by Mr. Minthorn, the first time it has been reported from that section of the state. The plants generally grow as scattered individuals but, under proper conditions, may form dense colonies, especially on low-lying lands.

CONTROL.

Measures to keep this pest in check should be directed toward preventing seed formation, the plants cut off in the early part of the second year, at the latest, before the erect stems have matured their heads. The stalks are succulent and easily cut by hoe or mower.

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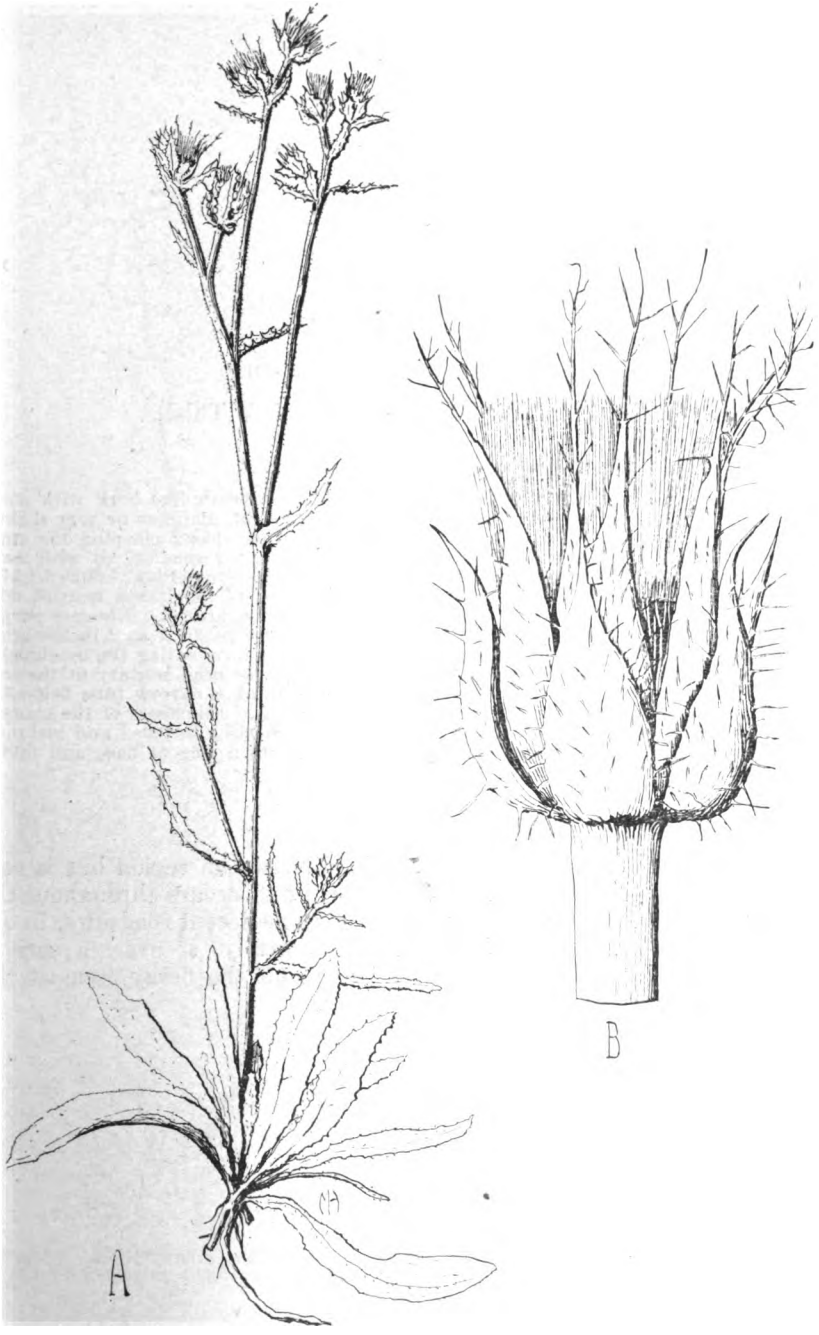

FIG. 58. Bristly Ox-Tongue (*Picris echioides*): A, Habit of a medium-sized plant. B, Head enlarged to show the involucral bracts surrounding the numerous fruits.

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MILK THISTLE.

(*Silybum marianum* Gaertn.)

English names: (1) Milk Thistle; (2) Lady's Thistle.

DESCRIPTION.

Habit: Annual or, in California, usually a biennial thistle-like herb with erect, simple, or more often branching stems, 2 to 6 feet in height, glabrous or very slightly hairy, bearing alternate oblong, pointed leaves with their bases clasping the stem, the lower 1 to 2 feet in length and half as wide, the upper smaller, all with wavy margins or the blade more or less deeply lobed, and bearing numerous yellow prickles, ⅛ to ½ inch long, the smooth and shining upper surface of the leaves mottled with whitish blotches, especially along the thick midrib and its laterals. *Flowers* purple, all perfect and with fertile ovaries, borne in large globose heads, 1 to 2 inches broad and armed with large, spreading or recurved, stout spines terminating the overlapping bracts of the involucre, each spine ¾ to 1.5 inches long, the head solitary at the ends of the branches. Corollas of the flowers all alike, forming a narrow tube below but flaring above beneath the 5 narrow free tips to the petals. Filaments of the stamens united as well as the anthers. *Fruit* 1-seeded, dry (achene), flattened and glabrous, bearing a crown of barbed bristles (pappus) united into a ring at base and falling away from the achene together.

DISTRIBUTION.

The Milk Thistle is a native of the Mediterranean region but is now widely distributed in all parts of the world and occurs throughout the coast region of California as a vagrant along neglected roadsides, in old pastures, and on vacant city lots. It is rarely, if ever, a serious nuisance and is easily controlled by hoeing off the fleshy stem at the surface of the ground.

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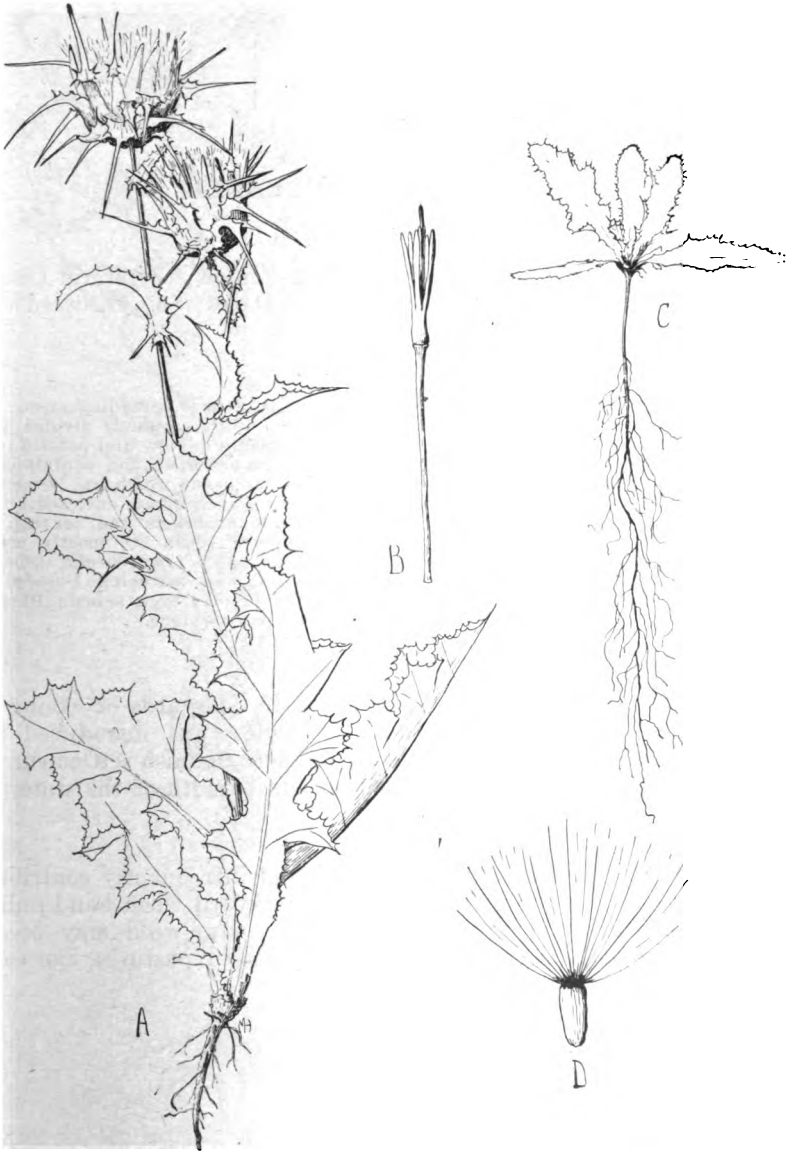

FIG. 59. **Milk Thistle** (*Silybum marianum*): A, Habit of plant bearing two of the large, spiny heads. B, Single floret. C, Seedling. D, Fruit (achene).

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MAYWEED OR DOG FENNEL.

(*Anthemis cotula* L.)

English names: (1) Mayweed; (2) Dog Fennel; (3) Fetid Chamomile; (4) White Stinkweed; (5) Stinking Daisy; (6) Dillweed; (7) Manzanillo.

DESCRIPTION.

Habit: Annual herb with erect, much branched, sometimes spreading stems, 1 to 2 feet high or rarely a foot higher, bearing numerous, alternate, finely divided leaves attached to the stems without leaf-stalks, the leaf segments narrow and pointed; both stems and leaves glabrous or rarely somewhat hairy, ill-scented, and containing an acrid juice irritating to the skin. *Flowers* in numerous heads which are borne aloft on naked stalks, 1.5 to 4 inches long, each head about 1 inch broad, enclosed at base by an involucre composed of several series of dry, blunt bracts and bearing both white ray-flowers and yellow disk-flowers. Ray-flowers 10 to 20, mostly neutral (i.e., without stamens or pistils), the white, strap-shaped, ray corolla generally 3-toothed at its tip. Disk-flowers numerous, perfect, and maturing 1-seeded dry fruits (achenes) interspersed with slender, awl-like bracts; each achene 10-ribbed and its surface roughened with numerous tubercles; pappus none.

DISTRIBUTION.

This familiar acquaintance, found living in dooryards or ekeing out a hardy existence along paths and roadsides, was introduced into California from Europe in the days of the early Spanish settlement and is now established throughout the length and breadth of the state.

CONTROL.

It rarely becomes a serious nuisance but not infrequently contributes to the general forlornness of an unkempt backyard when hand-pulling or hoeing would keep the intruder at bay. May-weed may become of some moment to stockmen since it survives in pastures, the cattle avoiding it.

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FIG. 60. May-weed or Dog Fennel (*Anthemis cotula*): A, Habit of a typical plant showing the finely divided herbage and numerous heads of flowers. B, Single head, enlarged, to show the flat, spreading rays and densely aggregated disk-flowers.

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HAIRY CAT'S-EAR.

(*Hypochaeris radicata* L.)

English names: (1) Hairy Cat's-ear; (2) Gosmore; (3) Long-rooted Cat's-ear; (4) Flatweed.

DESCRIPTION.

Habit: Perennial herb with 1 to several erect, smooth, slender, simple or more commonly branching stems, 6 inches to 2 feet tall, rising from the crown of a thick, fleshy, rather deeply penetrating taproot, 8 inches to 2 feet in length. *Leaves* with prominent midribs, all broad and spreading from just above the crown of the root except for a few scale-like leaves upon the otherwise naked stems; basal leaves 1.5 to 8 inches long, ⅛ to 1 inch wide, broadening to above the middle from the tapering stalk-like base and terminating in a rounded tip, the blades rarely entire, usually more or less lobed or toothed, the lateral lobes often with their tips projecting backward; both leaf surfaces covered with coarse, yellow hairs. *Flowers* in heads about 1 inch broad at the tops of the stems; heads basally surrounded by an involucre about 1 inch high, composed of distinct, green, erect, linear bracts arranged in two or three overlapping series, the shortest outside and all glabrous or sparsely hairy. Flowers spreading above the involucre, numerous, yellow, with corolla of 5 united petals, the upper part of the corolla developed as a flat ligule at one side of the 5 united stamens and central single style with forking stigma; each flower with a narrow, pointed, chaffy scale at its base. The ripe 1-seeded, dry, brown fruit (achene) ribbed and roughened by minute projections upon its surface, extended upward as a slender, thread-like beak bearing at its summit a tuft of white, silky, branched hairs (pappus); the old heads showing the white, flossy pappus only within the persistent involucral bracts.

DISTRIBUTION.

Two species of Cat's-ear are found as weeds in California: The species here described and the Smooth Cat's-ear (*H. glabra* L.), the latter with leaves devoid of hairs and the outermost achenes of the fruiting head not beaked. Both species are immigrants from the Old World which have become obnoxious as invaders of cultivated fields and pasture lands in the coast counties of California. As yet neither has gained much headway in the interior.

CONTROL.

Both species of Cats-ear are difficult to eradicate when once well established. Old pastures infested with these herbs generally harbor other undesirable plants and, indeed, the presence of Cat's-ear in numbers is a good sign that the pasture has deteriorated and may well be plowed preparatory to putting the land into tillage. In well-cultivated soil Cat's-ear does not long survive. It is stated by Georgia that land badly infested with cat's-ear may be cleared by running pigs upon it, the animals feeding upon the fleshy roots.

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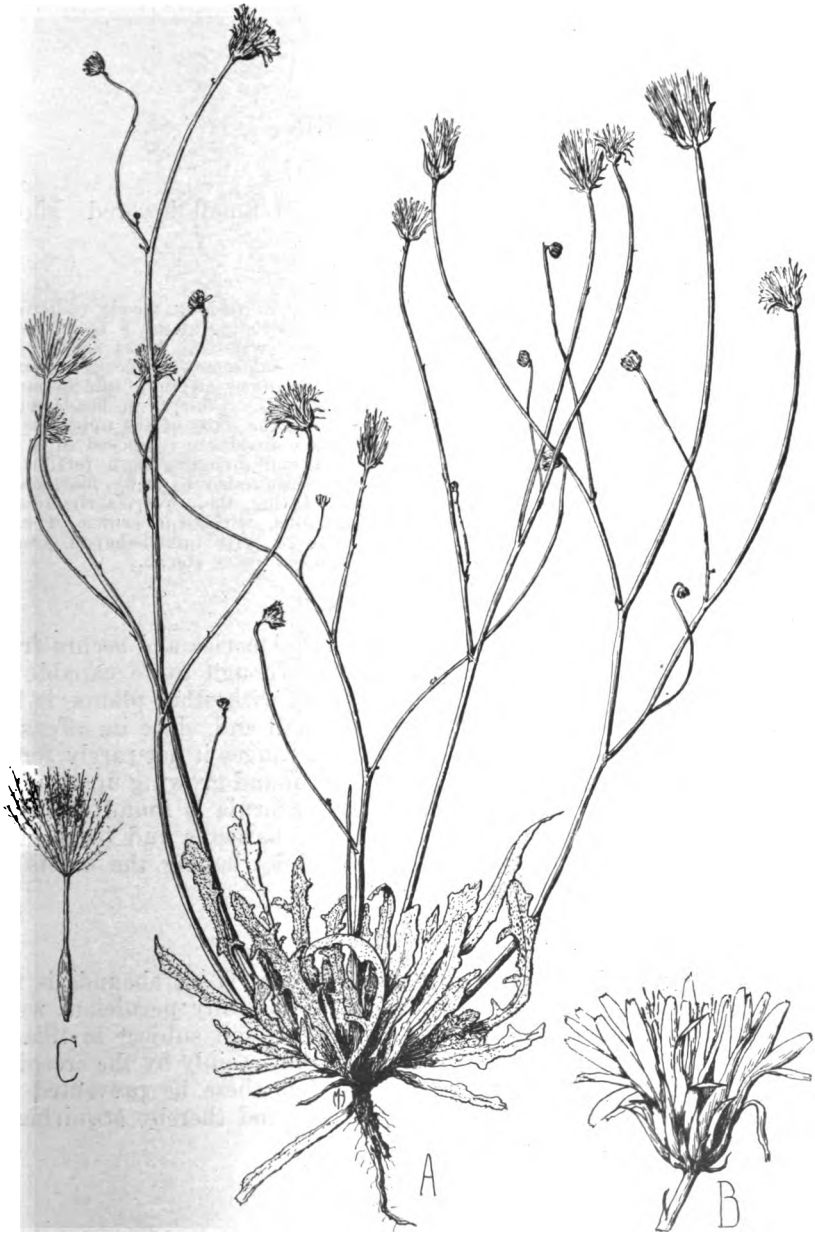

FIG. 61. Hairy Cat's Ear (*Hypochaeris radicata*): A, Habit of Hairy Cat's Ear. B, Head, natural size. C, Achene, enlarged.

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POVERTY WEED.

(*Iva axillaris* Pursh.)

English names: (1) Poverty Weed; (2) Small-flowered Marsh Elder.

DESCRIPTION.

Habit: Perennial herb of rank, unpleasant odor, with creeping, woody rootstocks, from which arises an urn-shaped cluster of erect or ascending stems, 8 to 20 inches high, bearing numerous, small, gray-green, entire, narrowly oval, blunt leaves, ½ to 1.25 inches long and 3/9 inch wide, faintly 3-nerved and somewhat fleshy, tapering to the base but not stalked, lower leaves opposite, the upper alternate and becoming smaller; both stems and leaves finely hairy or glabrous. *Flowers* in heads which hang downward from the ends of their short stalks in the axils of the upper leaves. Each head basally enclosed by a cup-shaped, shallow involucre composed of a few rounded, short bracts more or less joined together and including both fertile and sterile flowers, all without rays. Fertile flowers few in number (1 to 6), marginal in position, with short, tubular corollas or corollas wanting, their ovaries ripening to dry, 1-seeded fruits (achenes), flattened and glabrous, without a crown of hairs at the free end (no pappus). Sterile flowers 15 to 25, with funnel-shaped corollas and 5 stamens with anthers scarcely joined, the reduced ovary sterile.

DISTRIBUTION.

Poverty Weed is a native of western North America and occurs from the Canadian boundary south to Mexico. Though quite capable of maintaining itself in good soil in competition with other plants, it has the advantage of being able to withstand alkali and, since its offensive odor causes animals to reject it, on the open ranges it not rarely forms a large and increasing part of the vegetation found growing upon saline soils. In San Diego County and Lower California is found a closely allied plant (*I. hayesiana* Gray) of woody character and technically separated from the common Poverty Weed by having the bracts of the involucre quite free from each other.

CONTROL.

Fortunately much of the land where Poverty Weed abounds is too cheap to make the problem of controlling this really pernicious weed insistent, but when it is found infesting good soil subject to tillage, control becomes imperative. The plant spreads mainly by the creeping rootstocks and effective control requires that these be prevented by intensive cultivation from sending up shoots and thereby acquiring a new lease upon life.

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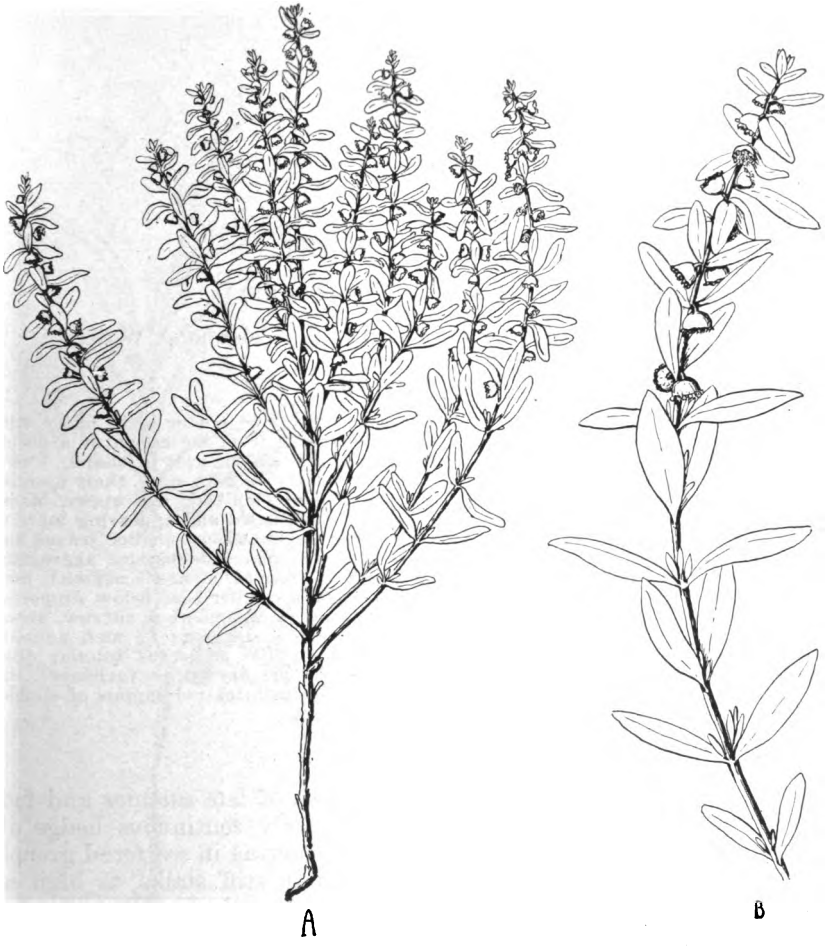

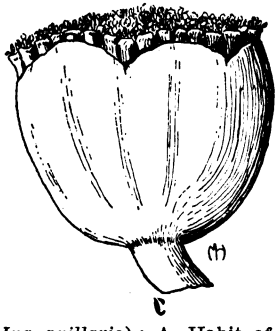

FIG. 62. Poverty Weed (*Iva axillaris*): A, Habit of Poverty Weed. B, A branch, natural size, showing the pendant heads in the axils of the upper leaves. C, Head, enlarged, to show the cup-like involucre and crowded flowers.

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TELEGRAPH PLANT.

(*Heterotheca grandiflora* Nutt.)

English names: (1) Telegraph Plant; (2) Telephone Weed.

DESCRIPTION.

Habit: Annual herb with 1 to several erect stems, 2 to 6 feet high, hairy with shaggy, spreading, gray hairs, branched above and rising from the crown of a deeply penetrating taproot. *Leaves* alternate, numerous, gray-green, oval in shape, 1 to 2 inches long and ½ to 1 inch wide, densely hairy or velvety on both sides, their margins slightly toothed and veins obscure; lower leaves long-stalked, the upper blades attached directly to the stems by broad, obscurely lobed bases and appearing more or less twisted; often with short axillary shoots bearing numerous smaller leaves and 2 to 4 heads. Glandular, hairy branches of the principal inflorescence aggregated at the tops of the stems, the heads arranged in a flat topped cluster (corymb), each head solitary at the tip of a branch or sometimes with a smaller head below supported on a lateral shoot; heads enclosed below by an involucre of numerous narrow, green, unequal bracts arranged in several series. The single head large (¾ inch across), containing about 30 marginal ray-flowers surrounding the numerous tubular disk-flowers, all with hairy ovaries which ripen into 1-seeded dry fruits (achenes), the ripe fruits of the disk-flowers surmounted by a persistent brick-red pappus of simple, straight hairs as long or longer than the silky achene.

DISTRIBUTION.

This is one of the most characteristic weeds of late summer and fall in southern California, often forming a nearly continuous hedge of varying height along the country roads, or occurring in scattered groups of two or three on vacant lots, where the tall, stiff stalks, as high as a man, suggest the popular names applied to the plant. Though most abundant in the coast counties of southern California, it is found as far north as Santa Clara County.

CONTROL.

Mow and burn before the heads are ripe if the plants are numerous; elsewhere hand-pulling is an effective way of keeping these unsightly summer weeds in check.

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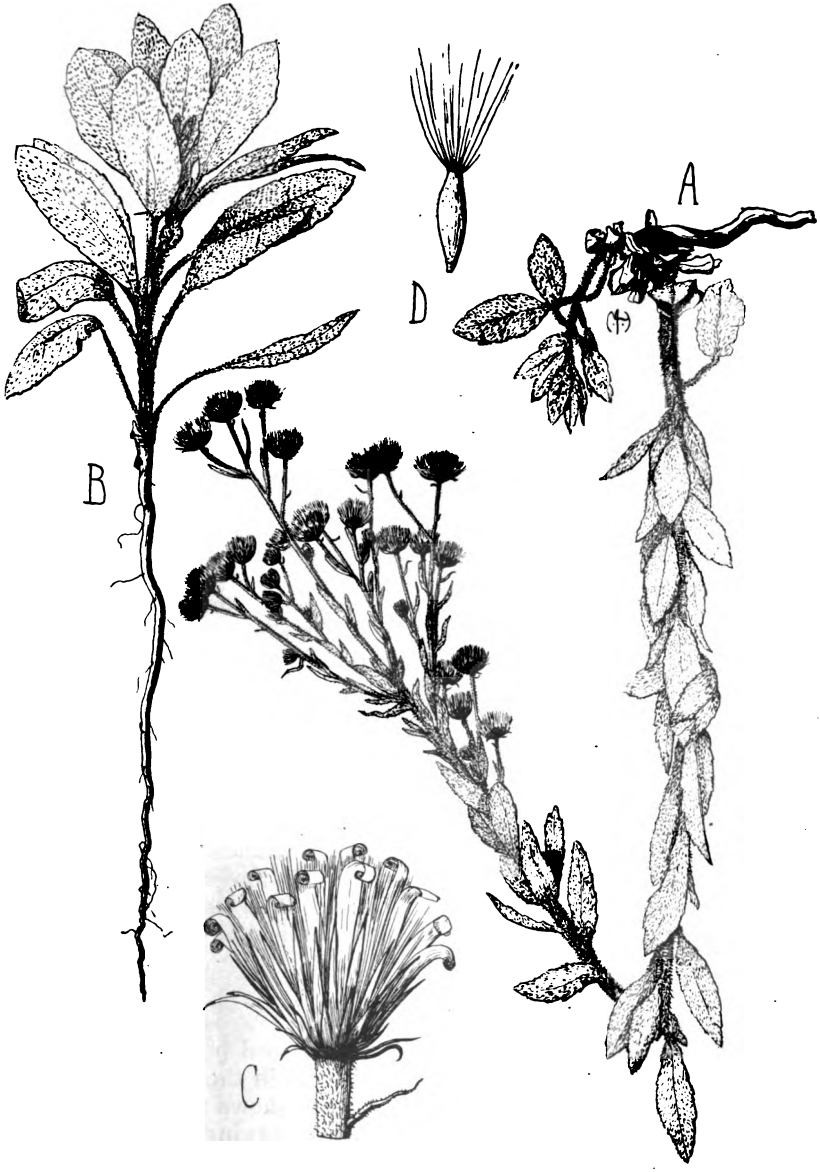

FIG. 63. Telegraph Plant (*Heterotheca grandiflora*): A, Habit of mature plant reduced. B, Seedling. C, Head showing the involucre and curling rays. D, Achene.

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COMMON COCKLEBUR.

(*Xanthium canadense* Mill.)

English names: (1) Common Cocklebur; (2) Sea Burdock; (3) Hedgehog Burweed; (4) Sheepbur; (5) Buttonbur; (6) Clotbur; (7) Ditchbur.

DESCRIPTION.

Habit: Coarse annual with stout central stem rising 2 to 4 feet high, its many branches ascending or widely spreading, rough, more or less angled and tinged with red or brown, or more or less irregularly spotted. *Leaves* somewhat heart-shaped at base, nearly entire or irregularly 3 to 5-lobed, the margins then coarsely toothed, 1.5 to 4 inches long and nearly as wide, roughened on both surfaces with minute bristles, conspicuously 3-nerved from the base, dark green above but lighter in color on the under side; leaf-stalks slender, as long or longer than the blades. *Flowers* in heads of two sorts: the small, inconspicuous, staminate heads in spikes at the tips of the branches, each head round (¼ inch in diameter), greenish-yellow, containing many small flowers with tubular corollas to which are attached stamens only; the very conspicuous pistillate heads grouped below the staminate or in clusters in the leaf axils, each head containing two flowers only enclosed in a spiny cylindrical bur (½ to 1 inch long and ⅜ inch in diameter) covered with hooked bristles and more or less hairy; burs terminated by a pair of stout beaks somewhat converging over the end or hooked at their tips; burs at first green but later turning brown, each containing 2 black seed-like fruits (achenes) that may retain their power to germinate for several years.

DISTRIBUTION.

Of the half-dozen species of *Xanthium* occurring as more or less serious pests in the eastern states but two, the Common Cocklebur above described and the following species, have so far been found within the state. Both are immigrants from the Old World tropics now established in all temperate and warmer zones and sometimes becoming veritable plagues (Argentine). The two species found in California are readily distinguished by the absence of the stem spines on the Common Cocklebur, the different leaf form, and the distinctive character of the bur of each species. The Common Cocklebur is especially common along neglected irrigation ditches, spreading by the floating burs; also it is apt to be abundant on low, moist soil where it can withstand a certain amount of alkali. It is especially obnoxious in pastures, the manes and tails of horses and tails of cattle becoming completely filled with the burs.

CONTROL.

Control measures must be directed toward seed prevention since the pest is prolific and its fruits may resist decay in the soil for a number of seasons. Field experiments appear to have shown that badly infested land may be cheaply cleared of cocklebur by spraying with a solution of copper sulphate (blue vitriol); a solution of one pound blue vitriol in ten gallons of water applied to the seedling plants when six inches to a foot high, is said to be effective.

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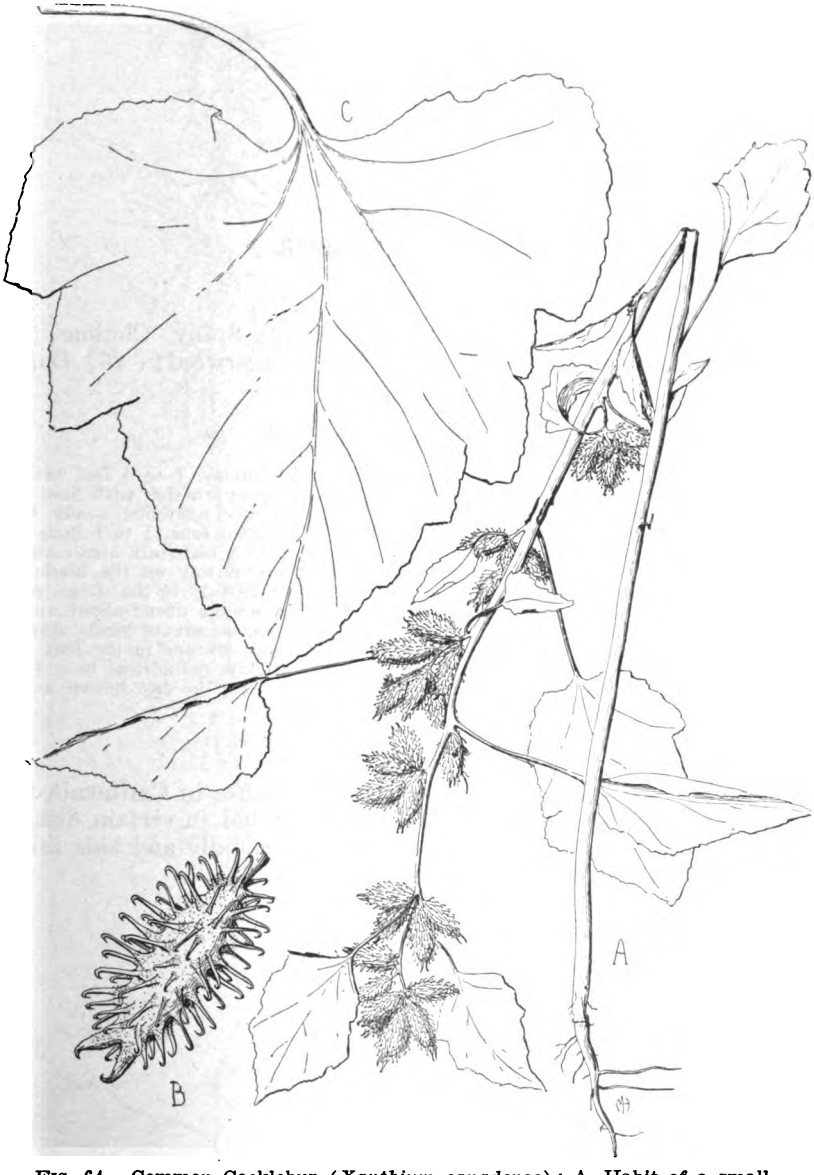

FIG. 64. Common Cocklebur (*Xanthium canadense*): A, Habit of a small, simple-stemmed plant. B, Bur. C, Leaf.

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SPINY COCKLEBUR.

(*Xanthium spinosum* L.)

English names: (1) Spiny Cocklebur; (2) Spiny Clotbur; (3) Clotweed; (4) Thorny Burweed; (5) Daggerweed; (6) Dagger Cocklebur; (7) Bathhurst Bur.

DESCRIPTION.

Habit: Annual with erect, rather slender, branching stems, 1 to 3 feet tall, the lower part light green in color, generally smooth; the upper grayish with fine, short hairs. *Leaves* alternate, bright green above save for the whitened wooly veins, white-downy beneath with a fine, dense wool, 1.5 to 4 inches long, ½ to 1 inch wide, pointed at the tips; the lower leaves narrowing at base to a leaf-stalk about an inch long and usually 3-lobed, the small lateral lobes about midway on the blade; the upper leaves very shortly stalked or the blades attached directly to the stems, nearly entire. In each leaf-axil a 3-pronged yellow spine, the middle prong about an inch long. *Flowers* in heads of two sorts: the small, greenish, staminate heads clustered in spikes at the tips of the branches; the pistillate heads solitary in the leaf axils, each containing 2 flowers enclosed in a light-yellow, prickly, cylindrical bur, ½ inch long, the smooth prickles spreading and hooked at their tips, the two brown achenes flattened and remaining within the bur.

DISTRIBUTION.

The Spiny Cocklebur so far is less of a nuisance in California than its more familiar ally, the Common Cocklebur, but in certain districts in the southern part of the state is increasing rapidly and bids fair to soon deserve the same evil report.

CONTROL.

[See Common Cocklebur.]

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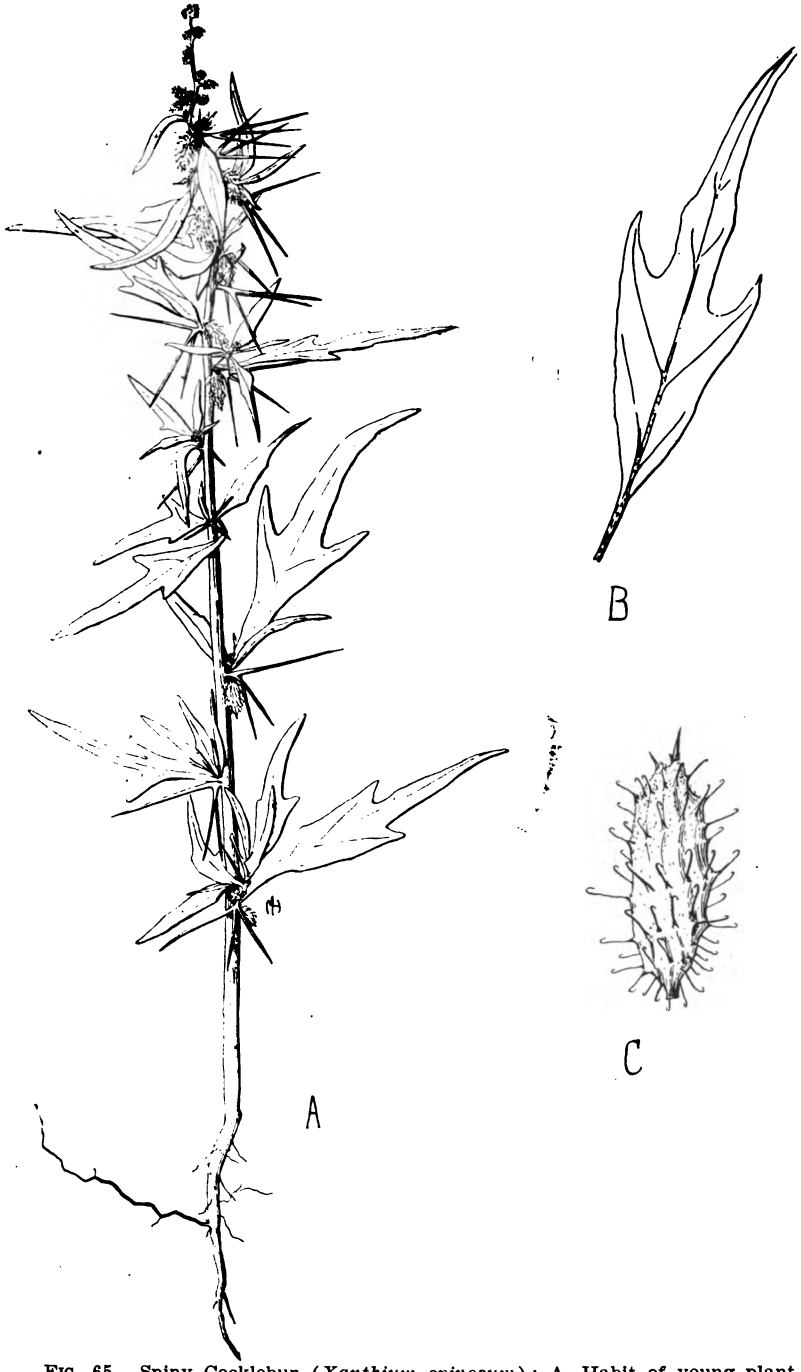

FIG. 65. Spiny Cocklebur (*Xanthium spinosum*): A, Habit of young plant bearing immature staminate heads at the top of the stem and pistillate burs below. B, Leaf form and venation. C, Bur.

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HORSEWEED.

(*Erigeron canadensis* L.)

English names: (1) Horseweed; (2) Canada Fleabane; (3) Butterweed; (4) Pride Weed; (5) Mare's-tail.

DESCRIPTION.

Habit: Annual (or, with us, biennial) herb with erect, slender, wand-like stems, 8 inches to 8 to 10 feet tall, with many slender branches near the top bearing the very numerous small heads of flowers; stem rough-hairy or sometimes nearly smooth, especially on the upper half. *Lower leaves* 1 to 4 inches long, strap-shaped or slightly broadening to above the middle and contracted at base to a leaf-stalk, their margins toothed or entire; upper leaves smaller, without contracted bases and entire; all the leaves usually hairy on both surfaces and margin. *Flowers* in heads, ¼ inch or less high, with bases enclosed by involucres composed of very small, pointed, green and smooth bracts arranged in 2 or 3 series and nearly completely concealing the many minute white rays and yellow disk-flowers. *Fruits* dry, 1-seeded (achenes), cylindrical in shape, 1/16 inch or less long, with their squarish summits bearing 8 to 10 straight, brown-yellow, spreading hairs (pappus), each about twice as long as the body of the achene.

DISTRIBUTION.

Though most of our weeds of field and garden are "undesirable immigrants," Horseweed is a native product, growing all over North America from Hudson Bay to Mexico and now well established in South America and in the Old World as a common nuisance. The genus *Erigeron* is one of the larger genera of the huge Sunflower Family of the flowering plants and includes a number of species considered weeds in the eastern states. None of these has yet been reported as pernicious in California but a recent arrival, already a pest in southern California and advancing northward, is *Erigeron linifolius* Willd., the narrow, green leaves suggesting the foliage of flax (*Linum usitatissimum*). This flax-leaved fleabane is a native of the tropics and gives promise of becoming thoroughly at home in all the warmer parts of the state. It never becomes as tall as Horseweed generally grows, two feet being about its extreme height; it is technically distinguished from Horseweed by its involucral bracts being covered with a dense, velvety coating of grayish hairs.

CONTROL.

Horseweed should be kept mowed along roadsides and hoed about dooryards and in fence corners, care being taken to cut the stems as near the ground as possible to prevent or minimize new shoots arising. Where abundant in grainfields, the stubble should be burned to kill the achenes and prevent added trouble next season.

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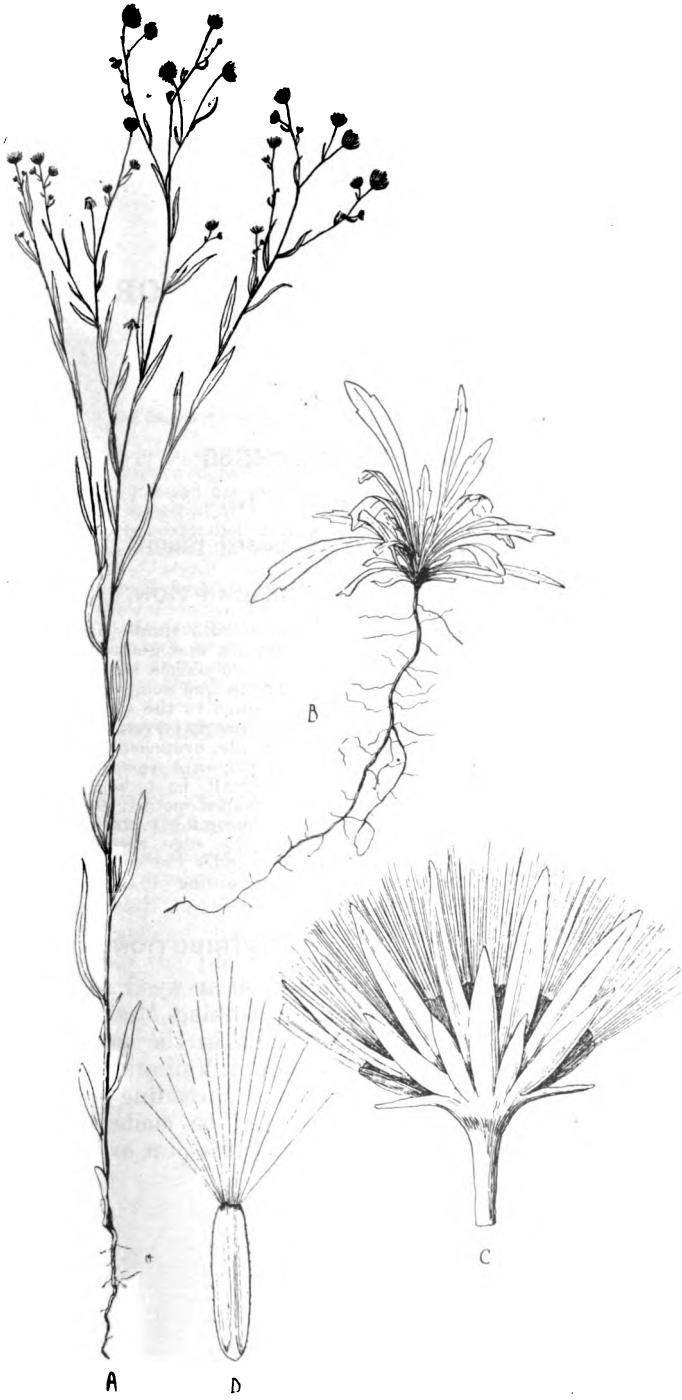

FIG. 66. Horseweed (*Erigeron canadensis*) : A, Habit of small-sized plant of horseweed. B, Seedling state. C, Head, enlarged, to show the involucre and the numerous achenes inside it. D, Achene with pappus.

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GROUP II

WEEDS OF SECONDARY IMPORTANCE

By F. J. SMILEY, Collaborator.

FIELD PENNYCRESS.

(*Thlaspi arvense* L.)

[FAM. Cruciferae—Mustard Family.]

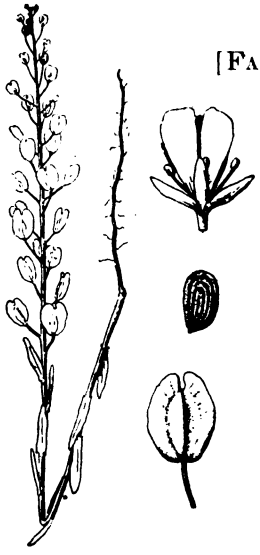

FIG. 67. Field Pennycress (*Thlaspi arvense*): Left, single small, simple-stemmed plant, x 1. Right, above, single flower, x 8; center, seed, x 10; below, pod, x 2.

DESCRIPTION.

Habit: Annual herb with simple or branching stem, ½ to 1.5 feet high, smooth and glabrous. *Lower leaves* stalked, the blades 2 to 4 inches long, broadening from the base to the blunt tip and somewhat toothed on the edges; upper leaves joined to the stem by broad, clasping bases, margins nearly even. *Flowers* minute, whitish, grouped in simple, branched clusters at the tops of the stems, each flower on a separate short stalk and composed of 4 very small, boat-shaped sepals and as many longer paddle-shaped petals, 6 stamens, and a single pistil. *Ovary* becoming a flattened pod broadly margined all around the edge except at the summit where a deep notch includes the very small style. *Pod* 2-celled, each cell containing 4 to 6 small, wrinkled seeds, red-brown in color.

DISTRIBUTION.

Naturalized European weed, sometimes called French-weed or Stinking Mustard, considered extremely injurious in the grainfields of the northern Mississippi Valley; now common in Modoc County and spreading south and west. Every effort should be made to prevent the further advance of this pest over the state.

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LOCO-WEED.

(*Astragalus antiselli* Gray)

[FAM. Leguminosae—Bean Family.]

DESCRIPTION.

Habit: Perennial herb with stems rising 1 to 1.5 feet high, covered with a dense white coat of short hairs and bearing compound leaves and greenish-white flowers. *Leaves* composed of 10 to 15 pairs of leaflets along the rachis of the compound leaf and one unpaired leaflet at its end, each leaflet linear-oblong, $\frac{1}{8}$ to $\frac{1}{4}$ inch in length, glabrous above, white-hairy beneath. *Flowers* small, grouped in loose racemes at the ends of the stems, the corolla shaped like that of the sweet-pea; pistil solitary. *Ovary* becoming a thin, glabrous, 1-celled pod, about $\frac{3}{4}$ inch long, tapering at base to a stalk (stipe) which protrudes from the persistent calyx and is pendant at the time the seeds are mature.

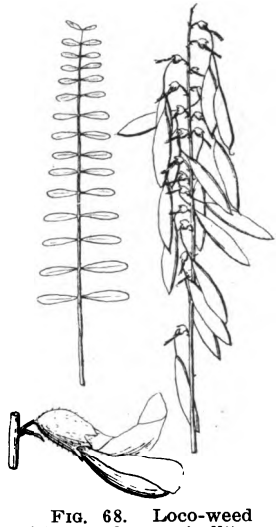

FIG. 68. Loco-weed (*Astragalus antiselli*): Above, leaf and raceme of pods, both x 1. Below, flower, x 4.

DISTRIBUTION.

Loco-weeds are numerous since *Astragalus* is one of the larger genera included in the flora of western North America. Some species have the pod swollen at maturity within which the dry seeds rattle when shaken (whence the name "rattle-weed" often applied to these plants); other species have flattened, compressed pods like the plant described above which grows on the grassy, open hillsides of the southern part of the state. [See U. S. Dept. Agr. Farmer's Bulletin 380 for description of several loco-weeds, their effect upon stock, and remedial measures.]

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COMMON CHICKWEED.

(*Stellaria media* Cyrill)

[FAM. Caryophyllaceae—Pink Family.]

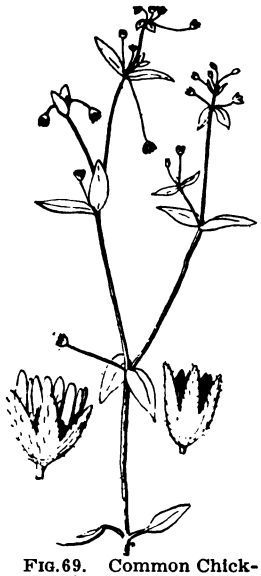

FIG. 69. Common Chickweed (*Stellaria media*): Center, part of a flowering stem, x 1. Left, fruit after rupture of the capsule, x 6. Right, flower, x 6.

DESCRIPTION.

Habit: Naturalized European annual (occasionally perennial with us) weed with weak, forking, somewhat juicy stems that strike root at the prominent joints and are marked lengthwise by lines of hairs. *Leaves* small, ½ inch in length or less, oblong in shape, the lower on hairy leaf-stalks, the upper leaves without stalks and narrower. *Flowers* small, white, composed of 5 free sepals and as many shorter petals, the latter deeply divided into narrow segments; stamens 3 to 7; pistil one with three styles and a single oblong ovary, the latter becoming a dry capsule containing many minute, round and flattened brown seeds, which are usually more or less covered with rows of small tubercles and show a notch and beak at one side.

DISTRIBUTION.

Very abundant in shady lawns or along the edges of shrubberies but easily kept within bounds by mower or clippers; sometimes a nuisance in truck gardens.

COMMON MAN-ROOT.

(*Echinocystus fabacea* Naud.)

[FAM. Cucurbitaceae—Gourd or Melon Family.]

DESCRIPTION.

Habit: Trailing or climbing vine with stems, 10 to 30 feet long, growing from a huge perennial root often as large as a man's body; stems bearing branching tendrils and ivy-like, thin, green leaves, 2 to 4 inches across and deeply 5 to 7-lobed. *Flowers* small, greenish-white, of two sorts: staminate and pistillate. Staminate flowers borne in few-flowered clusters in the leaf-axils; pistillate flowers solitary in the same axil on a separate, short stalk. Corolla of united petals. *Ovary* ripening to a rounded, spiny fruit, 2 inches in diameter, its stout spines ¼ to 1 inch long; seeds usually 4, ½ to 1 inch long and grooved or lined the long way around.

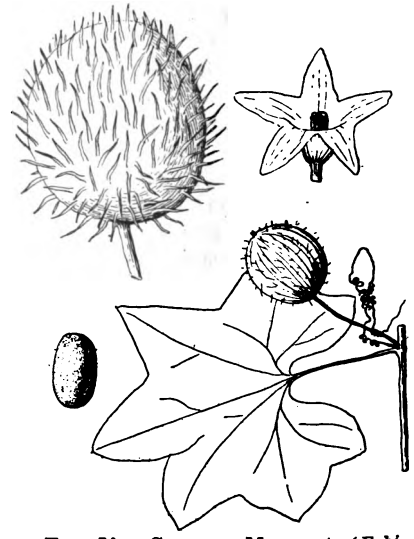

FIG. 70. Common Man-root (*Echinocystus fabacea*): Above, left, fruit of *E. fabacea*, x 1; right, staminate flower, x 4. Below, right, leaf, young fruit, and tendrils, x 1; left, seed, x 1.

DISTRIBUTION.

We have three other species of Man-root in California, all quite similar to Common Man-root in general appearance: one is the Chilicothe of the south (*E. macrocarpa* Green), with a longer fruit covered with long, yellow, but weak, spines and containing 12 to 14 seeds. Occasionally these vines become nuisances in fields and truck gardens, thorough eradication being difficult because of the great roots within which abundant food is stored, enough for several crops of stems.

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JIMSON-WEED.

(*Datura stramonium* L.)

[FAM. Solanaceae—Nightshade or Potato Family.]

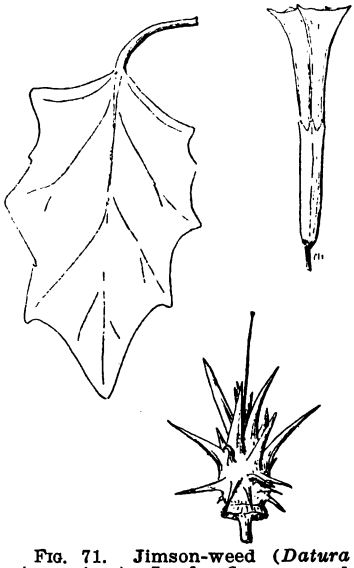

FIG. 71. Jimson-weed (*Datura stramonium*): Leaf, flower, and fruit. All natural size.

DESCRIPTION.

Habit: Coarse, rank-smelling, annual herb with stout, greenish stem rising 1 to 5 feet high and bearing large (3 to 8 inches long and half as wide), thin leaves, which are toothed or lobed and borne on stout leaf-stalks. *Flowers* very large, each on its own stalk in the stem-forking, very fetid; corolla white or lavender of 5 united petals, forming a narrow funnel about 4 to 5 inches long; calyx about half as long as the corolla; stamens 5, united by their long stalks to the inside of the corolla tube; the single 2-celled ovary ripening to a prickly oval capsule, 2 inches long, containing many good-sized, dark brown, flat seeds.

DISTRIBUTION.

Naturalized tropical weed found in vacant lots or in tilled fields in middle to late summer, containing a poisonous principle utilized in medicine. Control: Hoe off the stems before seed matures.

KNOT-GRASS.

(*Paspalum distichum* L.)

[FAM. Gramineae—Grass Family.]

DESCRIPTION.

Habit: Perennial grass, native of the warmer parts of America but apparently an introduced weed in California, spreading both by its grains and by the numerous creeping rootstocks (rhizomes). Culms ½ to 2 feet high. *Leaves* narrow, crowded, with blades 2 to 6 inches long, their sheaths more or less hairy. *Flowers* in spikelets, the latter aggregated into 1-sided spikes at the top of the culm, usually a pair of spikes only but occasionally one or two additional spikes.

DISTRIBUTION.

Knot-grass somewhat resembles Bermuda-grass but is coarser and the generally paired spikes are readily distinguished from the 4 or 5 finger-like (digitate), spreading spikes at the top of the Bermuda stem. Knot-grass is now to be found in all parts of the state, growing in wet pastures and along irrigation ditches, sometimes fouling the water channels to such a degree as to justify the name "Ditch-grass," by which this plant is sometimes known.

FIG. 72. Knot-grass (*Paspalum distichum*): Above, part of a tuft of knot-grass; one culm spike-bearing, x 1; spikelet, x 10. The two feathery stigmas are seen protruding from between the flowering scales.

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COMMON PURSLANE.

(*Portulaca oleracea* L.)

[FAM. Portulacaceae—Purslane Family.]

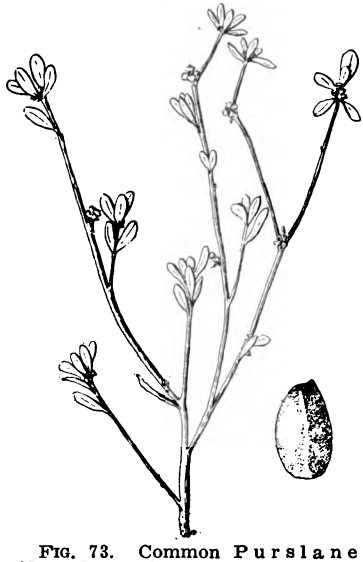

FIG. 73. Common Purslane (*Portulaca oleracea*): Part of a Purslane "mat," x 1. Seed, x 20, seen edgewise.

DESCRIPTION.

Habit: Fleshy, annual, glabrous herb of mat-like habit, the many prostrate and spreading stems rising from a deeply penetrating root-system and bearing numerous alternate, thick leaves somewhat wedge-shaped in outline but with well-rounded tips. *Flowers*: The small, yellow, unstalked flowers opening only in the sunshine, the 5 petals notched or lobed. Stamens 7 to 12. *Ovary* solitary, becoming a round capsule, the upper half of which breaking around the middle and coming off like a lid to free the many small, black and shining seeds; seeds rounded and somewhat flattened.

DISTRIBUTION.

Few gardens can be found wherein Purslane is not an unwelcome intruder at one time or another and few plants are more difficult to exterminate, the seeds long retaining their power of germination in the soil; ground once seeded may be expected to produce new plants year after year even though none is allowed to mature flowers and fruits.

LABRADOR TEA.

(*Ledum glandulosum* Nutt.)

[FAM. Ericaceae—Heath Family.]

DESCRIPTION.

Habit: Native evergreen shrub, 3 to 5 feet high, with thickish leaves, 1 to 2 inches long, short stalked, their blades entire, pointed at each end, green and glabrous on both sides or the underside lighter with a fine, felt-like covering of minute, white hairs; leaf margin somewhat rolled toward the underside. *Herbage* fragrant when rubbed or bruised. *Flowers* white, small and numerous in umbrella-like clusters at the ends of the branches, each flower with 5 minute sepals and as many larger (¼ inch long) petals surrounding the 10 stamens and single pistil. Stamens shedding their pollen through pores at the free ends of the anthers. *Ovary* becoming an oval capsule about ⅛ inch long, tipped for a time by the persistent withered style. *Seeds* numerous, small.

DISTRIBUTION.

Labrador Tea is justly feared as a poisonous plant by the stockmen who graze sheep on the forest ranges of the Sierra Nevada and North Coast Ranges. It has been proposed to conduct a persistent campaign against this common shrub of lake and stream margins but as yet nothing has been done in systematic fashion.

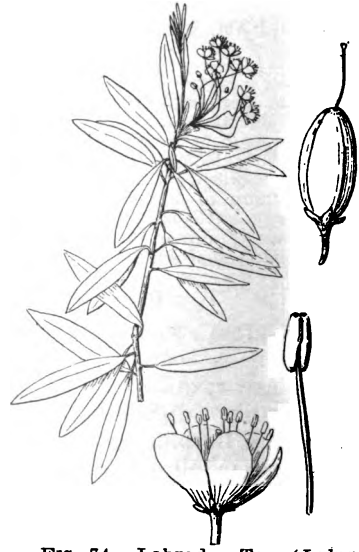

FIG. 74. Labrador Tea (*Ledum glandulosum*): Left, part of a flowering branch, x 1. Right, flower, x 4; stamen, x 20, showing the pair of pores at the top of the anther; fruit, x 8.

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CHEESE-WEED.

(*Malva parviflora* L.)

[FAM. Malvaceae—Mallow or Cotton Family.]

DESCRIPTION.

Habit: Biennial, coarse, widely-branching herb, native of Europe, 1.5 to 3 feet high. *Leaves*. 1 to 5 inches broad, of rounded outline, but with 6 to 7 shallow lobes, borne on leaf-stalks 3 to 4 inches long, venation prominent. Upper sides of stems and leaf-stalks more or less hairy with forking white hairs (stellate pubescence). *Flowers* aggregated in rather dense clusters in the leaf-axils, each flower on a short stalk. Calyx of 5 united sepals joined for about one-half their length and bearing near the base 3 small linear bractlets. Corolla pinkish, the 5 free petals slightly longer than the sepals. Stamens numerous, their stalks (filaments) united to form a tube about the styles. *Ovary* becoming a dry fruit enclosed by the persistent calyx; fruit ultimately breaking into about a dozen segments (carpels), each containing a single seed.

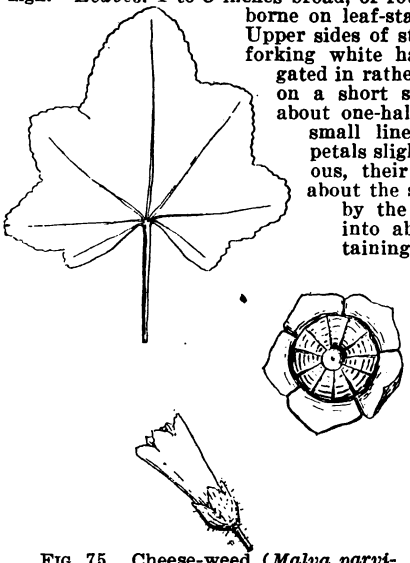

FIG. 75. Cheese-weed (*Malva parviflora*): Above, leaf of *M. parviflora*, x 1. Below, flower of *M. rotundifolia*, x 16. Right, fruit of *M. parviflora*, x 16.

DISTRIBUTION.

Very common weed of spring and early summer about all neglected dooryards, gardens, or other enclosures and commonly associated locally with two nearly related species distinguished by the following key:

Corolla but little longer than the calyx, the petals scarcely noticeable; leaves distinctly lobed----(1) *M. parviflora*
Corolla about twice as long as the calyx; leaves indistinctly lobed.
Mature carpels hairy on their backs ----------(2) *M. rotundifolia*
Mature carpels without hairs on their backs----------(3) *M. borealis*

The two species with long corollas are commonly known as (2) Dwarf Mallow and (3) Bull Mallow; all three are Old World immigrants.

CARPET-WEED.

(*Mollugo verticillata* L.)

[FAM. Aizoaceae—Carpet-Weed Family.]

DESCRIPTION.

Habit: Mat-forming, much branched, glabrous annual, not at all fleshy in character, with clustered leaves and minute white flowers. *Leaves* in whorls of 5 to 6, unequal but averaging about ½ inch in length and scarcely a fourth as wide. *Flowers* several at each joint of the stem, each flower on a thread-like stalk; petals none but the sepals white on the inner side and persistent, resembling petals when the flowers are open. Stamens usually 3. Pistil solitary. *Ovary* ripening to a dry capsule, enclosing many small, shining, orange-red seeds of kidney shape.

DISTRIBUTION.

Naturalized from tropical America and found generally distributed in California as a weed of sandy soils about dwellings or along roadsides.

FIG. 76. Carpet-Weed (*Mollugo verticillata*): Part of a "mat," x 1. Fruit, x 16, enclosed by the calyx.

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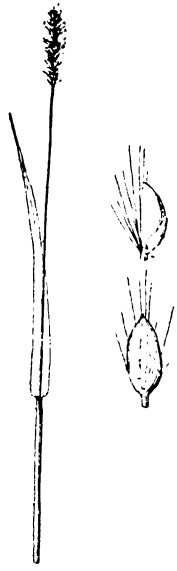

FIG. 77. Bristly Foxtail (*Setaria glauca*): Left, upper part of spike bearing culm, x ½. Right, above, lateral aspect of grain showing attachment of the bristles. Below, Grain as seen on the inner face.

BRISTLY FOXTAIL.

(*Setaria glauca* Beauv.)

[FAM. Gramineae—Grass Family.]

DESCRIPTION.

Habit: Annual grass with erect, leafy culms, 1 to 2 feet high, which branch at the base. *Leaf-blades* 4 to 12 inches long, flat and slightly twisted, somewhat harsh; leaf-sheaths loosely investing the culm, often tinged with red, especially the lower sheaths. *Flowers* in spikelets aggregated into dense, bristly spikes at the tops of the culms, spikes 1 to 4 inches in length, the tawny, yellow bristles ½ inch long or less rising from the stalks of the spikelets. Spikelet producing a single grain enclosed by the following scales (lemma and palea) and appearing wrinkled.

DISTRIBUTION.

Bristly Foxtail (otherwise called Foxtail Millet, Yellow Foxtail, Pigeon Grass) is a native of Europe, early spread as a field weed in the eastern states in impure seed grain but as yet not very common in California though reported from Sacramento to Riverside.

VELVET WEED.

(*Gaura parviflora* Douglas)

[FAM. Onagraceae—Evening Primrose Family.]

DESCRIPTION.

Habit: Annual herb with soft-hairy herbage, the hairs whitish; stems 2 to 5 feet high, erect and scarcely branching. *Leaves* alternate, very shallowly, wavy-margined or nearly entire, borne on short, ascending leaf-stalks. *Flowers* grouped in dense spikes terminating the stems, each flower appearing stalked by the free floral parts being borne on the summit of the slender, stalk-like ovary (inferior ovary); petals 4, white or rose-colored at first but fading reddish. *Ovary* becoming a glabrous (or essentially so), 4-angled capsule, narrowed to both ends and enclosing 3 to 4 seeds.

DISTRIBUTION.

The genus *Gaura* includes some dozen and a half species of western North America, all of which are commonly spoken of as Butterfly Weeds. One of these, the plant just described, has lately attracted attention as a possibly serious weed of cotton fields in the Imperial Valley, spreading by the fruits drifting in irrigating water. Another species, *G. sinuata*, with flowers more than twice as large as those of *G. parviflora* and the leaves conspicuously and sharply toothed, has been recognized in nursery stock in Los Angeles and Santa Barbara.

FIG. 78. Velvet Weed (*Gaura parviflora*): Right, upper part of a flowering stem of *G. parviflora* showing erect leaf habit and dense nodding flower cluster. Left, above, single flower; below, mature fruit, x 6.

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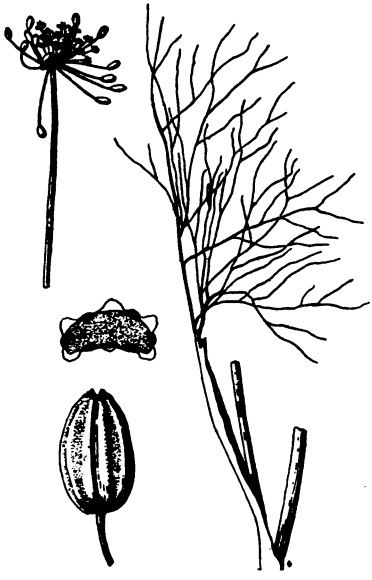

FIG. 79. Sweet Fennel (*Foeniculum vulgare*): Left, above, single secondary umbel, x 1. Below, mature fruit, x 8. Center, cross-section of a half-fruit showing the location of the oil-tubes (black dots) in the depressions between the ribs, x 8. Right, leaf, x 1.

SWEET FENNEL.

(*Foeniculum vulgare* Gaertn)

[FAM. Umbelliferae—Parsley or Celery Family.]

DESCRIPTION.

Habit: Stout, erect, and glabrous perennial herb with dark green, aromatic herbage, the streaked stems rising 2.5 to 7 feet in height and freely branching. *Leaf-blades* many times divided into linear segments; leaf-stalks lighter in color, inflated and clasping the stem. *Flowers* small, yellow, grouped in large, compound, umbrella-like clusters (umbels), each ray of the primary umbel itself terminated by a secondary umbel of 12 to 20 flowers. Flower with 5 minute sepals and as many alternate yellow petals which enroll their tips; stamens 5; pistil 1, the inferior ovary surmounted by a flattened cushion (stylopodium), bearing the 2 short styles. *Ovary* developing into a 2-celled, dry, ribbed fruit which splits at maturity into halves, each about ¼ inch long.

DISTRIBUTION.

Very common invader of waste lots in southern and central California, in such locations often forming a sort of coppice covering the property. Control by hoeing off the stems two or three times a season as near the surface of the ground as possible.

CALABAZILLA.

(*Cucurbita foetidissima* H. B. K.)

[FAM. Cucurbitaceae—Squash or Melon Family.]

DESCRIPTION.

Habit: Rough, prostrate vine of unpleasant odor, with stout stems, 6 to 16 feet in length, growing from the summit of a large, carrot-shaped root, stems striking root at their joints and bearing branched tendrils, large, alternate leaves, and large, yellow flowers. *Leaves* triangular in shape, 4 to 12 inches long and half as broad, borne on stout leaf-stalks, the blades rough above and hairy below. *Flowers* usually solitary, of two sorts, staminate and pistillate, corollas 2.5 to 4 inches long. Stamens 3, their anthers elongated and more or less intertwined. *Ovary* solitary, inferior, becoming a dry, round, smooth gourd, 2 to 4 inches in diameter, containing many seeds inside its thick rind.

DISTRIBUTION.

The Calabazilla is a native representative of the family which gives us melons, pumpkins, cucumbers, etc. It grows most abundantly in southern California though present in the Great Valley as far north as Stockton. The Mock Orange (*C. palmata* Watson), of practically the same range as the above, may be distinguished by its palmately (hand-shaped) 5-parted leaves.

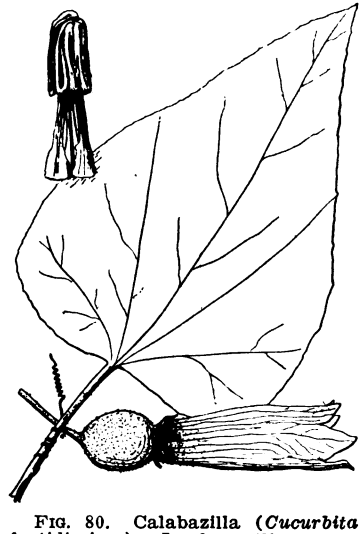

FIG. 80. Calabazilla (*Cucurbita foetidissima*): Leaf outline and venation of Calabazilla, x 1. Left, anther column from staminate flower, x 2. Right, pistillate flower, x 1; note the round ovary beneath the corolla.

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CAT-TAIL.

(*Typha latifolia* L.)

[FAM. Typhaceae—Cat-tail Family.]

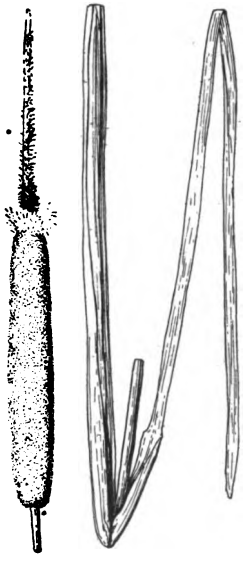

FIG. 81. Cat-tail (*Typha latifolia*): Left, spike showing the naked stalk from which the staminate flowers have fallen and below it the pistillate cluster of developing fruits, x ½. Right, leaf, x ½.

DESCRIPTION.

Habit: Perennial marsh herb with erect, unjointed, stout and pithy stems, 4 to 7 feet high, rising from creeping, scaly rootstocks and bearing long, alternate grass-like leaves with sheathing bases, and terminated by dense flower clusters. *Flowers* of two sorts: staminate and pistillate; the former consisting of 3 stamens surrounded by numerous bristles, the latter of a single ovary also enveloped by bristles. Staminate flowers grouped in a light-yellow spike at the top of the stem, pistillate similarly aggregated below, the two clusters forming a more or less continuous spike ½ to 1 foot or more in length. *Fruits* minute, enveloped in the "cotton" of the "cat-tail." The staminate flowers after flowering fall away from the axis of the upper cluster, the axis persisting above the "cat-tail" as a naked, fuzzy stalk.

DISTRIBUTION.

Cat-tails are too well known to require much description though not a few people in California confuse cat-tails and "tules" in spite of the very different appearance of the latter (*q. v.*). Cat-tails are primarily a nuisance as a weed in over-irrigated lands, their appearance indicating excessive soil moisture, or as choking irrigating ditches. When once established, they are not easy to eradicate unless the land is drained.

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WATER HEMLOCK.

(*Cicuta occidentalis* Greene)

[FAM. Umbelliferae—Parsley or Celery Family.]

DESCRIPTION.

Habit: Tall, branching, perennial, marsh herb with stout, hollow stems rising 3 to 5 feet from a short, thick, erect rootstock or cluster of rootstocks. Rootstocks divided internally into a number of shallow cavities. *Leaves* twice compound (pinnate) ½ to 1.5 feet in length, the leaflets narrow, 2 to 3 inches long, their margins finely toothed and sometimes 1-lobed on the side away from the midrib. *Flowers* small, white, grouped in large, terminal, compound clusters (umbels), the branches of which are unequal in length and capped by secondary umbels (umbellets) of 6 to 10 flowers each. The single, inferior ovary becomes a 2-celled, ribbed, somewhat cylindrical fruit which at maturity splits into halves, each containing a single, flattened seed.

FIG. 82. Water Hemlock (*Cicuta occidentalis*): Left, above, primary umbel with ten rays and as many umbellets, x 2. Center, fruit, x 12. Below, longitudinal section through rootstock showing the internal cavities. Right, leaf, x ⅛.

DISTRIBUTION.

Water Hemlock also called Poison Parsnip and Cowbane) is one of the most poisonous of our native plants, each year recording loss from stock eating it, and fatal cases have occurred in California of both adults and children being poisoned by eating the rootstocks. All parts of the plant are poisonous though the underground parts are relatively the most toxic. The plant is widely spread in the state along streams and in tule swamps. [See Bulletin 249, Agr. Experiment Station, Univ. of California.]

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FULLER'S TEASEL.

(*Dipsacus fullonum* L.)

[FAM. Dipsaceae—Teasel Family.]

DESCRIPTION.

Habit: Biennial herb of coarse, stout habit, the erect, simple, prickly stems 3 to 6 feet high. *Leaves* large, opposite, sessile, the bases of the upper leaves grown together, about the stem-joints forming cups (in which water may collect after showers—hence a common name, Venus'-cup). *Leaf* broadly oblong, somewhat sickle-shaped, the lower leaves becoming a foot in length, the upper shorter. *Flowers* aggregated in short spikes at the ends of the stems, the spikes surrounded at base by an involucre of spiny, unequal bracts. Single flower small, pinkish white, each accompanied by 4 bracts with recurved tips. *Fruit* small, dry, 1-seeded (achene).

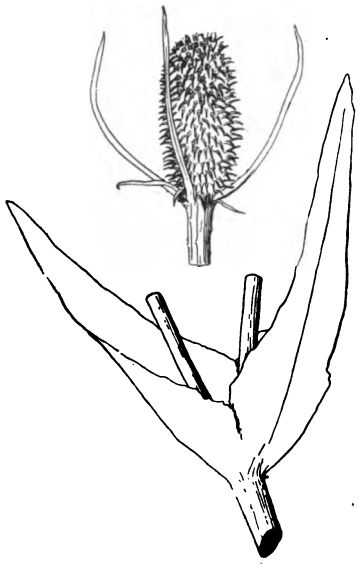

FIG. 83. Fuller's Teasel (*Dipsacus fullonum*): Above, a fruiting head or spike, x 1. Below, two of the upper leaves showing the cup formed by their joined bases.

DISTRIBUTION.

Fuller's Teasel is a native of the Old World, somewhat famous in the history of cloth-making since the rigid, dry heads were used in medieval Europe to raise a nap upon cloth, the recurved tips of the floral bracts slightly tearing and pulling out the threads when the heads were drawn over the cloth. It is an example of an "escaped" plant, the parent form (*D. sylvestris*) having no recurved tips to the floral bracts; apparently these hooks were the result of a "sport" that occurred in ancient times and later maintained by cultivation. Fuller's Teasel is found locally in California as a weed of waste places, occasionally too abundant in pastures.

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WILD TOBACCO.

(*Nicotiana glauca* Graham)

[FAM. Solanaceae—Nightshade or Potato Family.]

DESCRIPTION.

Habit: Evergreen shrub or small tree 6 to 18 feet high, the stems soft and nearly herbaceous, slender and freely branching, the branches usually drooping. *Leaves* alternate, entire, glaucous and glabrous-clammy, 12 inches long or the upper shorter, borne on leaf-stalks about a third as long as the blades; leaf-form ovate or sometimes squarish at base. *Flowers* in loosely branched racemes (panicles) at the ends of the branches, the corollas greenish-yellow, 1 to 2 inches long, composed of united petals with tube flaring above the short calyx and constricted just below the 5 free tips to the petals. Stamens 5, attached to the inside of the corolla tube. Pistil 1, its ovary seated on a yellow disk and ripening to a dry, many-seeded fruit (capsule) which ruptures at the top.

DISTRIBUTION.

Native of South America and early introduced into California where it is now found generally distributed in all the warmer parts of the state, growing along streams or occasionally invading city lots. Herbage poisonous to cattle.

FIG. 84. Wild Tobacco (*Nicotiana glauca*): Left, top of a flowering shoot, x. 1. Right, above, ripe dehisced capsule, x 4; below, young leaf, x 1, showing usual form and venation.

WESTERN AZALEA.

(*Rhododendron occidentale* Gray)

[FAM. Ericaceae—Heath Family.]

FIG. 85. Western Azalea (*Rhododendron occidentale*): Flower, x 1. Fruit (capsule) ruptured to free the seeds, x 2. Whorl of leaves, x 1. (All figures of *Rhododendron occidentale*.)

DESCRIPTION.

Habit: White (or pink) flowered, deciduous shrub growing along stream-banks, the ascending stems 3 to 7 feet high and bearing alternate, entire leaves crowded toward the ends of the flowering branches in whorl-like fashion. *Leaves* 1 to 4 inches long, elliptic in shape, smooth and shining, hairy along the edges. *Flowers* in terminal clusters (umbels), fragrant; calyx small but corolla 1.5 to 3 inches long, composed of 5 petals and somewhat 2-lipped, the upper lobe with a large, yellow blotch; stamens 5; the single style long protruding. *Fruit* in capsule about ¾ inch in length, containing numerous brown seeds.

DISTRIBUTION.

Distributed from Monterey County northward to Oregon along water-courses; also in the Sierra Nevadas. Closely allied to the above species is *R. californicum* (California Rose-Bay), an evergreen shrub ranging from California (Santa Clara County) to Washington in the Coast Range and Cascade Mountains; with thick, leathery leaves and rose-purple flowers. The herbage of both of these beautiful shrubs is more or less poisonous to sheep, and stockmen will do well to explore mountain ravines for their presence before permitting sheep to graze freely.

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SKUNKWEED.

(*Gilia squarrosa* H. & A.)

[FAM. Polemoniaceae—Phlox Family.]

DESCRIPTION.

Habit: Annual, ill-scented herb about a foot high or less, blooming in late spring or early summer, occasionally simple-stemmed but more often many-branched from the base, hairy and sticky-glandular. *Leaves* alternate, deeply divided (pinnatifid), the segments often again deeply incised and rigid-spiny, grayish-green in color. *Flowers* in terminal, bur-like, bracted clusters, the corolla light blue. *Ovary* becoming a 3-celled capsule containing many small seeds.

DISTRIBUTION.

Skunkweed is a common member of that weedy border which too often lines for miles our country roads in summer; it is also abundant in grainfields and hayfields after harvest. Native from Monterey and Merced counties northward to Oregon. Burning roadsides and stubble will tend to keep this and similar nuisances in check.

FIG. 86. Skunkweed (*Gilia squarrosa*): Branch showing foliage and flower clusters, x 1. Single flower with two of the spiny bracts which enclose the head, x 4.

WILD OATS.

(*Avena fatua* L.)

[FAM. Gramineae—Grass Family.]

FIG. 87. Wild Oats (*Avena fatua*): Left, part of a panicle showing the hanging spikelets. Right, single spikelet, x 1; note the two outer empty scales (glumes) within which one sees 3 bent awns borne on the lemmas of as many florets.

DESCRIPTION.

Habit: Introduced annual grass, native of Europe, with culms 1 to 3.5 feet high, erect and stout for grass culms. *Leaf blades* long and broad, harsh with stiff hairs; leaf-sheaths loosely enveloping the culm. *Flowers* in spikelets which are grouped in an open panicle, each spikelet pendent from a thread-like stalk. *Spikelets* 2 to 3-flowered as a rule, the empty scales (glumes) about an inch long; lower flowering scale (lemma) and its stalk clothed with stiff and long brown hairs; lemma with a long, somewhat bent awn attached to its back, the awn usually twisted below. The flowers soon fall from between the glumes which remain attached to the stalk of the spikelet.

DISTRIBUTION.

Wild Oats is a common weed on the coast from Canada to Mexico and yields a considerable amount of wild hay in the Great Valley of California. It is chiefly obnoxious as an intruder in grainfields, along with a closely related species, *A. barbata* (Barbed Oats), also an Old World immigrant. Barbed Oats is a less robust plant than Wild Oats from which it is technically distinguished by having two fine awns, about $\frac{1}{16}$ inch in length, terminating the teeth at the summit of the lemma; in Wild Oats the lemma teeth are pointed but not awn-tipped.

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BRASS BUTTONS.

(*Cotula coronopifolia* L.)

[FAM. Compositae—Sunflower Family.]

DESCRIPTION.

Habit: Perennial half-fleshy, glabrous herb of wet soil, strong-scented, the generally many stoutish stems clustered and spreading on the ground, ½ to 1 foot long. *Leaves* alternate, variously shaped (linear or oblong, entire, coarsely toothed, or deeply lobed on the same plant), their bases forming short sheaths about the stem; herbage yellowish-green in color. *Flowers* in flattish-rounded heads, about ½ inch broad, borne on long, naked stalks at the ends of the stems, each head enveloped beneath by an involucre of greenish bracts arranged in two series. Flowers of the head numerous, appearing all alike (no ray-flowers), the outer row pistillate and without corollas, the rest perfect or imperfect, their corollas yellow. *Fruit* an achene, shorter or longer stalked and more or less wing-margined. Pappus none.

FIG. 88. Brass Buttons (*Cotula coronopifolia*): Part of a branch bearing two heads, x 1. Head, x 4.

DISTRIBUTION.

Immigrant from South Africa and now found everywhere in the lower parts of the state, especially on saline ground, blooming nearly all the year. A less common but closely related plant is *C. australis* (native of Australia), an annual with hairy herbage which is not all succulent and all leaves finely divided into linear segments, now becoming fairly common in some of the towns and cities near the coast as a street weed.

FIG. 89. California Mugwort (*Artemisia heterophylla*): Left, top of a flowering stem, x 1. Right, above, single head, x 8; below, lower leaf, x 1, showing lobing.

CALIFORNIA MUGWORT.

(*Artemisia heterophylla* Nutt.)

[FAM. Compositae—Sunflower Family.]

DESCRIPTION.

Habit: Common, herbaceous weed of moist soil with simple, erect stems rising 2 to 6 feet high from slightly woody bases. *Leaves* large, alternate, 2 to 4 inches long, the blades oval or oblong with pointed tips; the upper leaves generally entire, the lower deeply incised with the clefts extending downward; leaves green on the upper side, white-downy beneath; herbage bitter. *Flowers* in small heads which are generally borne erect, though some more or less nodding, the heads aggregated into dense spikes grouped in a large panicle at the top of the stem. Heads without ray-flowers, enclosed at base by an involucre of overlapping, dry bracts and including the 12 to 24 yellowish-green disk flowers, the marginal florets pistillate, the central perfect. *Fruit* a smooth achene destitute of pappus.

DISTRIBUTION.

This is one of the most widely distributed of our native weeds, being found from one end of the state to the other, growing along streams and irrigating ditches, in low-lying pastures, or along roadsides and railway rights-of-way. Hand cutting is about the only way to cope with the full-grown plants though the young seedlings are easily mown.

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NONESUCH, BLACK MEDICK.

(*Medicago lupulina* L.)

[FAM. Leguminosae—Bean Family.]

DESCRIPTION.

Habit: Introduced European herb with herbage somewhat soft-hairy, the crown of the perennial root bearing few to many spreading and reclining stems, each 8 to 20 inches long. *Leaves* 3-foliate, the central leaflet stalked; leaflets broader above the middle with full, rounded tips, their margins minutely toothed. Stipules present at the base of the leaf-stalks, their edges jagged. *Flowers* small, bright yellow, grouped in oblong or cylindrical heads on stalks (peduncles) 1 to 3 inches long in the leaf-axils. Corolla shaped like that of the sweet-pea. *Ovary* becoming a pod, flattened and spirally curved, nearly glabrous and black when ripe, containing a solitary yellow or greenish seed. *Seeds* frequently found as impurity in alfalfa seed.

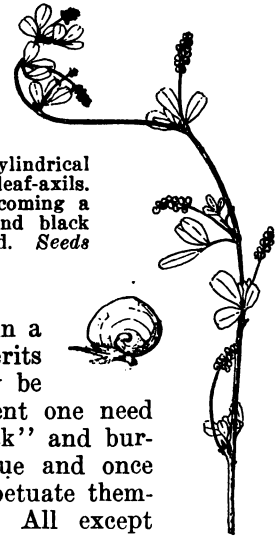

FIG. 90. Nonesuch, Black Medick (*Medicago lupulina*): End of a fruiting stem of Nonesuch showing the 3-foliate leaves and stalked clusters of pods, x 1. Single pod, x 10.

DISTRIBUTION.

The Medicks are not to be justly included in a "rogue's gallery" of plants since their merits far outweigh whatever harm may occasionally be caused by them; to substantiate this statement one need only remember that alfalfa itself is a "medick" and bur-clover another. All possess some forage value and once in possession of the ground they tend to perpetuate themselves by means of their long-lived seeds. All except alfalfa (*M. sativa*) are yellow-flowered and Black Medick differs from Bur-clover (*M. hispida*) in lacking the prickles which make the coiled, several-seeded, bur-like pod of the latter anathema to wool-buyers.

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LARKSPUR.

(*Delphinium glaucum* Watson)

[FAM. Ranunculaceae—Buttercup Family.]

FIG. 91. Larkspur (*Delphinium glaucum*): Left, raceme showing position of the flowers, x 1. Right, above, single flower, x 3; the nectar-producing petals are enclosed by the spur; below, small leaf, x 1, showing character of the lobes.

DESCRIPTION.

Habit: Tall perennial herb with leafy stems 2 to 6 feet high, bearing deeply 5 to 7-parted, hand-shaped leaves, the largest 6 inches broad on leaf-stalks 3 to 4 inches long; each lobe of the leaf somewhat wedge-shaped at base and coarsely and irregularly toothed on its margins; herbage glabrous. Stipules absent. *Flowers* many, blue or purplish, somewhat hairy, grouped in racemes at the tops of the stems, each flower growing on a flower-stalk ½ to 1 inch long with a slender bract at its base. Flower horizontal, composed of 5 united sepals, the upper prolonged behind as a deep spur; petals 4, in unequal pairs; stamens numerous; pistils few (seldom more than 3), developing into as many free pod-like fruits (follicles), each about an inch long and containing many small seeds.

DISTRIBUTION.

California's flora includes over a dozen species of larkspur, all objects of interest to the lover of wild-flowers but all looked upon with growing disfavor by the stockman since many of our kinds are definitely known to be poisonous to cattle and horses. These herbs grow in the mountain meadows or on moist hillsides and in the young state are apt to be grazed by stock, often with serious results. [See Bulletin 249, Agr. Experiment Station, Univ. of California.]

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FIELD HORSETAIL.

(*Equisetum arvense* L.)

[FAM. Equisetaceae—Horsetail Family.]

DESCRIPTION.

Habit: Perennial, flowerless, rush-like plant with 3 kinds of jointed, ribbed stems: subterranean root-stocks from which arise both branched and unbranched aerial stems; joints of the stems solid, the intervening sections hollow. Branched aerial stems sterile, 1 to 3 feet high, the 4-angled branches in whorls at the stem joints, branches 4 to 6 inches long, numerous. Unbranched aerial stems terminated by a cone. *Leaves* reduced to mere scales united by their margins and sheathing the stem joints. Cone of the unbranched (fertile) stems 1 to 4 inches long, composed of whorls of stalked umbrella-like scales (sporophylls) on the underside of which are attached 5 to 8 sacks containing the very numerous olive-green, 1-celled *spores*, each wrapped by a pair of *elaters*.

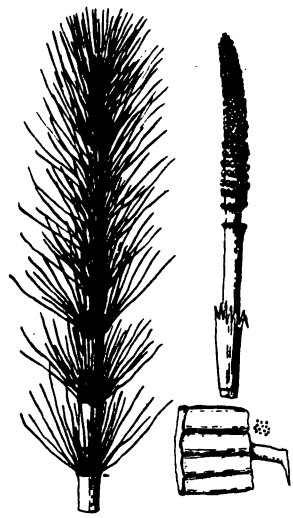

FIG. 92. Field Horsetail (*Equisetum arvense*): Left, upper part of a sterile stem, x 1. Right, above, mature spore-discharging cone, showing the whorls of scales (sporophylls), x ½; below, single scale, x 20, showing the stalk, flattened surface and 4 of the spore-sacks (sporangia).

DISTRIBUTION.

Horsetails commonly grow in marshy soils not generally cultivated and can be exterminated by drainage. Though sometimes so abundant as to become a nuisance, the chief importance that this and other species of *Equisetum* have for farmers is due to the toxic character of their herbage. The poison of horsetail is particularly harmful to horses; sheep are less affected and cattle seem immune.

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DEATH CAMAS.

(*Zygadenus venenosus* Watson)

[FAM. Liliaceae—Lily Family.]

DESCRIPTION.

Habit: Herbaceous plant of moist meadows with grass-like foliage and simple, erect, solid stems, 1 to 2 feet high, growing from an oblong bulb which is covered with brown sackcloth-like outer scales. *Leaves* smooth, long-linear, mainly basal on the stems, generally curving and somewhat folded along the prominent midrib; leaf margins roughened with minute teeth. *Flowers* greenish-white, grouped in a raceme at the top of the stem; raceme 5 to 10 inches long, the flower-stalks growing out of the axils of very narrow, long-pointed bracts. Flower composed of a perianth (calyx and corolla combined) of six segments, all contracted to a short claw at base upon which is a green gland; stamens 6, each as long as the perianth segments; pistil one with 3 distinct, persistent styles. *Ovary* ripening to a deeply 3-lobed capsule containing 18 to 24 seeds in the three cells.

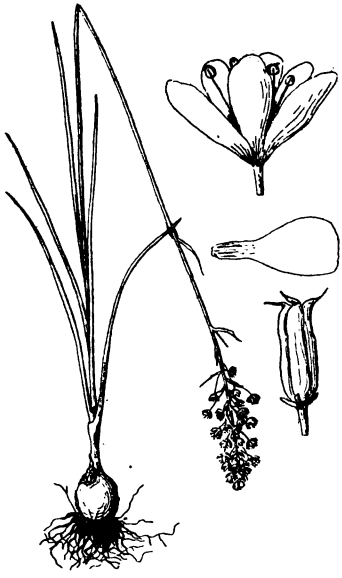

FIG. 93. Death Camas (*Zygadenus venenosus*): Habit showing bulb, foliage, and flowering stem, x ⅛. Flower, x 8. Perianth segment, x 8, showing the "claw" at base. Capsule, x 4.

DISTRIBUTION.

The Death Camas is distributed in California in moist meadows in the Coast Region from Monterey County northwards and in the Sierra Nevadas as far south as the San Joaquin, causing annually the loss of thousands of sheep. Cattle and horses avoid the plant while hogs readily eat the bulbs, their relish for them giving a common name to the plant—"hog potato." There is another species of this genus in our flora (*Z. fremontii* Torrey) which goes by the name of the Star Zygadene; this grows only in the Coast Range of central California and apparently causes no loss from grazing stock. This plant may be distinguished from the Death Camas by its stamens only half as long as the perianth segments and only the *inner* whorl of perianth segments contracted to a claw at their bases.

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AUSTRALIAN SALT-BUSH.

(*Atriplex semibaccata* R. Br.)

[FAM. Chenopodiaceae—Goosefoot Family.]

DESCRIPTION.

Habit: Perennial, much-branched and leafy, Australian half-shrub, the bases of the many prostrate stems woody but their tops herbaceous, branchlets slender, whitened and somewhat glistening. *Leaves* ½ to 2 inches long, oblong-elliptic, short-stalked, their margins usually irregularly and shallowly toothed or wavy but not rarely entire, upper leaf-surfaces light green, lower silvery. *Flowers* of two sorts, staminate and pistillate, both on the same plant (monoecious); staminate flowers grouped in short spikes at the ends of the branchlets; pistillate flowers solitary or in 2's or 3's in the leaf axils. Staminate flower without petals, composed of a 4 to 5-parted calyx surrounding as many stamens, the flower bractless; pistillate flower consisting of a single pistil only, enveloped by a pair of fleshy bracts which become reddish when the fruit is mature. *Fruit* a 1-seeded, bladdery utricle.

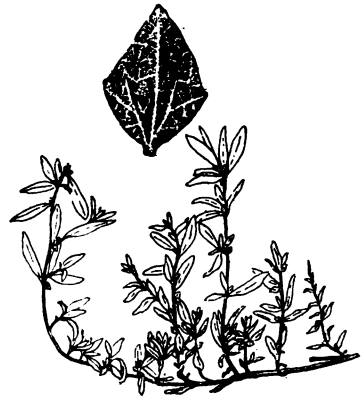

FIG. 94. Australian Salt-bush (*Atriplex semibaccata*): Below, end portion of a trailing branched stem, x 1. Above, fruiting bract of pistillate flower, x 12.

DISTRIBUTION.

This plant was introduced into the state some thirty years ago with the thought that it would prove a valuable addition to the native forage growing on our desert or alkaline soils. Its value has not been as great as anticipated though it has taken to Californian conditions readily enough and is now completely established in many places in southern California.

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COMMON GROUNDSEL.

(*Senecio vulgaris* L.)

[FAM. Compositae—Sunflower Family.]

DESCRIPTION.

FIG. 95. Common Groundsel (*Senecio vulgaris*): Upper part of a flowering plant of *S. vulgaris*, x 1. Head, x 4; note the erect involucral bracts and the minute spreading ones below. Achene, x 4; note the pappus hairs at the top.

Habit: Annual weed, naturalized from Europe, with simple or branching, hollow, fleshy stems, 6 to 15 inches high and leafy to the top, more or less hairy. *Leaves* deeply lobed with jagged margins, the lower leaves tapering at base into a leaf-stalk; upper leaves directly attached to the stem by broadened, clasping bases. *Flowers* yellow, grouped in heads which are aggregated into clusters at the ends of the flowering branches. Heads small, about ¼ inch high, surrounded at base by an involucre composed of very narrow, erect, green bracts with black tips and a few minute spreading bracts below. Flowers of the head numerous (15 to 25), all alike with tubular corollas, no ray-flowers present. *Ovaries* becoming dry, 1-seeded fruits (achenes), somewhat hairy and finely ribbed, surmounted by a crown of silky, straight hairs (pappus).

DISTRIBUTION.

Groundsel has accompanied the European to all parts of the globe, being one of the commonest wayside and garden weeds, flowering in all seasons of the year. The genus *Senecio* is one of the largest recognized by botanists, embracing at least a thousand distinct species scattered all over the world, our native flora containing some two score. Besides Common Groundsel there is another introduced species slowly becoming naturalized in places along the coast and so different in aspect from the other forms as to warrant mention: This is the so-called "German Ivy," a twining perennial with bright green ivy-like foliage and small heads of yellow flowers (*S. mikanioides* Otto, a native of South Africa).

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CRAB-GRASS.

(*Digitaria sanguinalis* Scop.)

[FAM. Gramineae—Grass Family.]

DESCRIPTION.

Habit: Old-World annual grass of pale green color, the stout culms 1 to 3 feet long, more or less prostrate at base but ascending above, often striking root at the lower swollen joints. *Leaves* 2 to 5 inches long, ¼ to ½ inch wide, rather flaccid and harsh on both surfaces, their sheaths more or less rough-hairy with long, stiff, white hairs. *Flowers* in spikelets, the latter in pairs on two sides of the angled branches of the inflorescence; spikelet with one perfect flower, the outer scales (glumes) very unequal, the fertile scale (lemma) thickened and starchy.

DISTRIBUTION.

Cosmopolitan weed of all warmer countries and abundant in both waste and cultivated land in the southern half of California, especially rank growing on neglected irrigating ditches or in poorly drained alfalfa fields. Under certain conditions in California the herbage of Crab-grass seems to develop a bitter taste, causing stock to reject hay mixed with it. In the southern states it is considered a valuable volunteer forage grass. The weed is spread not only by the grains but also by the stems which may strike root if carried to new soil.

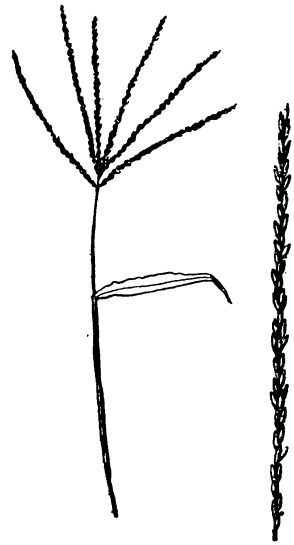

FIG. 96. Crab-grass (*Digitaria sanguinalis*): Top of a culm showing the finger-like cluster of spikelet-bearing branches of the inflorescence, x 1. Single branch of the inflorescence, x. 4.

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CHAPPARAL BROOM.

(*Baccharis pilularis* DC.)

[FAM. Compositae—Sunflower Family.]

DESCRIPTION.

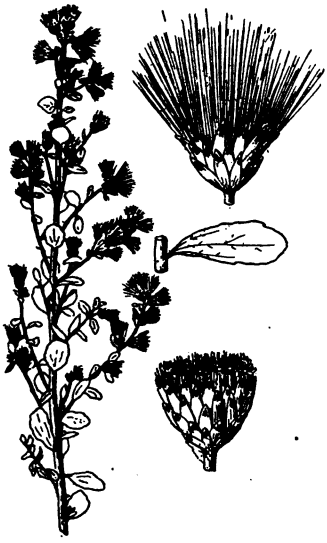

FIG. 97. Chapparal Broom (*Baccharis pilularis*): Left, top of a fruiting (pistillate) plant of Chapparal Broom, x 1. Right, below, staminate head, x 3; above, pistillate head in fruit, x 3; center, leaf, x 1.

Habit: Native perennial evergreen shrub 2 to 8 feet high (on exposed coastal slopes sometimes depressed or even prostrate), with angular branches, sessile leaves, and unisexual flowers. *Herbage* more or less sticky with a resin. *Leaves* small, wedge-shaped, ½ to 1 inch long, coarsely toothed, wavy-margined, or sometimes entire. *Flowers*: Staminate and pistillate flowers on different plants (dioecious flowers), grouped in small heads which are solitary or clustered in the leaf-axils or at the ends of the branches. Heads without rays, all the flowers with tubular, whitish corollas, those of the pistillate plants very slender or thread-like, the staminate corollas larger *Ovaries* of the pistillate flowers ripening to dry, 1-seeded fruits (achenes) with abundant hairy crowns (pappus); those of the staminate flowers abortive (i. e., not developing seed) but crowned with pappus hairs dilated at their tips.

DISTRIBUTION.

Besides Chapparal Broom, which is so common a shrub of the drier hillsides in the Coast Range from Los Angeles County northward to Oregon, our native flora contains several other species of *Baccharis*, one of which is the so-called Mule-Fat (*B. viminea*), a shrub with willow-like leaves 1.5 to 4 inches long and flesh-colored flowers, found distributed over the southern half of the state in damp soil and often forming dense thickets; it may become a nuisance on irrigating ditches.

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ARTICHOKE.

(*Cynara scolymus* L.)

[FAM. Compositae—Sunflower Family.]

DESCRIPTION.

Habit: Stout, robust, perennial herbs with streaked, fleshy stems 2 to 4 feet high, branched above. *Leaves* large (6 inches to 1 foot long), deeply cut (pinnatfid), the lobes themselves somewhat incised and spinescent; foliage whitish or hoary with fine hairs. *Flowers* blue, all alike, grouped in great heads 1 to 3 inches across, enclosed by involucres of broad, overlapping, leathery bracts; tips of the bracts more or less sharply pointed or a few spinescent. *Ovaries* becoming 4-angled, smooth, dry, 1-seeded fruits (achenes) which are enlarged upward and crowned by a ring of mainly branched hairs (pappus) with their bases united and falling away together from the fully ripe fruit.

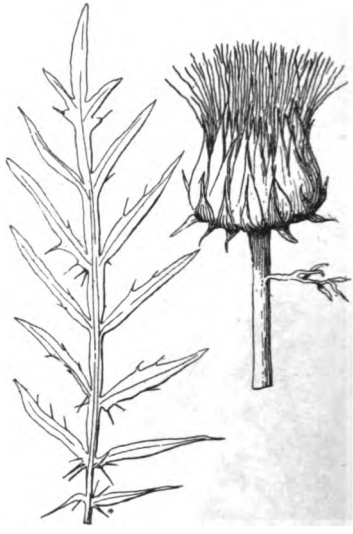

FIG. 98. Artichoke (*Cynara scolymus*): Leaf, x ½. Head, x 1.

DISTRIBUTION.

This is the original of the garden or French artichoke which has escaped from gardens and resumed in part its wild characters of spininess and diminished size of the heads; naturalized in some localities: Los Angeles, Berkeley, Benicia, Napa, etc.

BLESSED THISTLE.

(*Cnicus benedictus* L.)

[FAM. Compositae—Sunflower Family.]

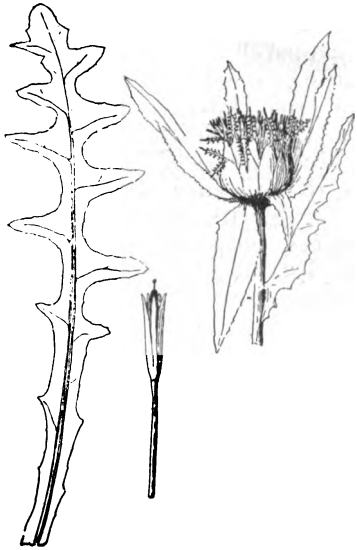

FIG. 99. Blessed Thistle (*Cnicus benedictus*): Leaf, x 1. Flower, x 4. Head, x 1; note the surrounding leaves and the comb-like tips to the inner involucral bracts.

DESCRIPTION.

Habit: Annual, prickly herb with branching, juicy stems, 1 to 2 feet high and somewhat hairy, bearing alternate, thin, green leaves and yellow flowers in rather large heads. *Lower leaves* distinctly stalked, the upper with clasping bases, all 3 to 6 inches long, their edges excessively jagged with unequal teeth; teeth of the leaf-edges usually spiny. Heads solitary, enveloped by the leaves crowded near the ends of the stem branches, each head 1.5 to 2 inches across and surrounded at base by an involucre of overlapping bracts, the inner bracts with long, branching spines. *Flowers* numerous, their ovaries ripening to 1-seeded, dry fruits (achenes), each with a crown (pappus) of dry scales (awns) arranged in two series, the outer long and yellow, the inner much shorter and white.

DISTRIBUTION.

The Blessed Thistle (also called Bitter Thistle) is a native of southern Europe now naturalized in the Great Valley.

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COMMON BURDOCK.

(*Arctium minus* Bernh.)

[FAM. Compositae—Sunflower Family.]

DESCRIPTION.

Habit: Coarse biennial weed, native of Europe, the rough, branching stem 3 to 7 feet high, bearing large, alternate, stalked leaves and rather large heads of pink or purplish flowers. *Leaves* thin and green above, their margins entire or shallowly wavy-scalloped, 4 to 8 inches long or the lowermost longer and about half as broad, the tips bluntly pointed; leaf-stalks as long as the blades, stout and usually hollow. Heads numerous, short-stalked or nearly sessile, ½ to 1 inch broad, enveloped below by a globose involucre of numerous overlapping, thick bracts, which end in long, stiff, hooked tips forming the bur. *Ovaries* of the flowers becoming 1-seeded, dry fruits (achenes), oblong in shape but somewhat flattened and wrinkled transversely, terminated by a pappus composed of numerous rough bristles which fall separately from the ripe fruit.

FIG. 100. Common Burdock (*Arctium minus*): Left, upper part of flowering stem showing the arrangement of the heads and shape of the upper leaves, x 1. Right, above, lower leaf, x ½; below, head, x 1.

DISTRIBUTION.

Burdock is now reported from several stations in the state (Mendocino County, Kings County, San Francisco) and is sure to spread. The nearly allied Great Burdock (*A. lappa* L.) is now naturalized at Riverside; it may be distinguished from the plant described above by its larger heads with their involucres as long as the flowers and practically concealing them.

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POISON OAK.

(*Rhus diversiloba* T. & G.)

[FAM. Anacardiaceae—Sumach Family.]

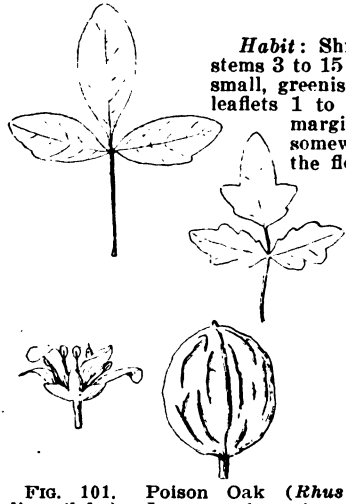

FIG. 101. Poison Oak (*Rhus diversiloba*): Leaves showing variation in leaf outline, x 1. Flower and fruit, x 8.

DESCRIPTION.

Habit: Shrub with erect or sometimes clambering vine-like stems 3 to 15 or more feet long, alternate, compound leaves, and small, greenish-yellow flowers. *Leaves* trifoliate, the glistening leaflets 1 to 4 inches long with entire or irregularly toothed margins and prominent veins. *Flowers* grouped in somewhat drooping panicles at the ends of the branches, the flowers appearing with the foliage in early spring, each flower about ⅛ inch long, composed of 5 (or rarely 4) sepals and as many petals, the latter with curling edges and occasionally black-dotted, 5 stamens and a single pistil, the ovary ripening to a stone-fruit (drupe) of whitish color streaked with lines.

DISTRIBUTION.

Poison Oak (so-called in spite of having no relationship whatever to the true oaks) is known to many people by repute though very often those who have suffered from its effects, do not recognize the plant in the open. As a matter of fact there are few shrubs with which Poison Oak should be confused; recollection of the characters indicated in the description should make recognition easy. The shrub ranges throughout California in the foothills of both the Coast Range and the Sierra Nevada, often forming dense thickets on the hillsides, especially where the ground is moist and shade present.

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CREEK NETTLE.

(*Urtica holosericea* Nutt.)

[FAM. Urticaceae—Nettle Family.]

DESCRIPTION.

Habit: Perennial herb with erect, simple stems, 2 to 6 feet high, bearing opposite stalked leaves and small, greenish flowers grouped in clusters of short spikes in the leaf-axils. *Leaves* simple, pointed, 3 to 5 inches long and an inch wide, gray-green in color, the blades with toothed edges and prominently veined. Herbage thickly beset with stinging hairs. *Flowers* of two sorts, staminate and pistillate, all without petals. Staminate flowers consisting of 4 distinct sepals and as many stamens; pistillate flowers formed of a bell-shaped calyx of 2 to 4 segments and a single pistil, the ovary of which develops into an achene (1-seeded, dry fruit) enclosed by the persistent calyx.

FIG. 102. Creek Nettle (*Urtica holosericea*): Upper part of a flowering stem of *U. holosericea*, x 1, showing the spike-like flower-clusters in the leaf-axils. Part of a cluster of fruits, x 8.

DISTRIBUTION.

The Creek Nettle is widespread in California, growing in damp places and usually conspicuous by reason of its tall stems overtopping other vegetation. The Creek Nettle and the Coast Nettle (*U. californica* Greene), the latter of somewhat similar appearance but having dark green leaves with heart-shaped bases, are both native species, the former ranging from one end of the state to the other, the latter from central California northward. Sometimes found with these native nettles is an immigrant weed of European origin, *U. urens* L. (Small Nettle), an annual plant with leaf stems about a foot high and only sparingly hairy, now found common in waste places and neglected gardens from San Francisco to San Diego.

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WILD HEMP.

(*Sesbania macrocarpa* Muhl.)

[FAM. Leguminosae—Bean Family.]

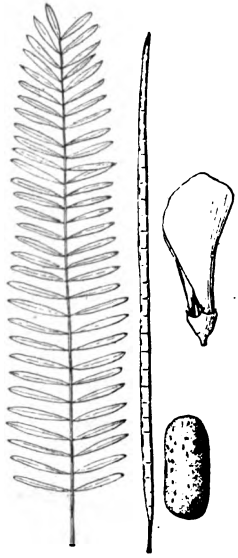

FIG. 103. Wild Hemp (*Sesbania macrocarpa*): Leaf, x 1. Pod, x 1. Flower, x 3. Seed, x 10.

DESCRIPTION.

Habit: Annual, tall herb, the glabrous, branching stems rising 5 to 10 feet high and bearing large, compound leaves, 4 inches to nearly a foot long, and yellow flowers in lateral, simple-stalked clusters (racemes). *Leaves* composed of 10 to 30 pairs of leaflets, each leaflet about an inch long and ¼ inch wide, broader above the middle and bluntly pointed, pale on the underside. *Flower* shaped like that of a sweet-pea, usually yellow but sometimes reddish or whitish, about ½ inch long, the petals often purple spotted. *Ovary* ripening to a long (12 inches or less), slender, jointed pod containing many brown-spotted seeds.

DISTRIBUTION.

This weed is a late immigrant from Arizona into the Imperial Valley where it has spread along the irrigating canals and into adjacent fields. The dry stems are tough and fibrous, difficult to cut, though the young shoots can be readily mown before flowering begins. It promises to spread to other districts of southern California.

BUFFALO-BUR.

(*Solanum rostratum* Dunal.)

[FAM. Solanaceae—Potato Family.]

DESCRIPTION.

Habit: Annual prickly herb, the erect, branching stems and leaf-stalks armed with yellow, slender prickles ⅛ to ¼ inch long, stems 1 to 2 feet high. *Leaves* 2 to 6 inches long, deeply cut, the lobes blunt and with irregular margins. Herbage densely coated with a copious coating of yellow, forked hairs (stellate pubescence). *Flowers* yellow, in shape like a potato flower, about one inch broad, grouped in racemes, each flower on a short stalk about ¼ to ½ inch in length; calyx densely hairy and prickly, at first smaller than the flat-topped corolla but persisting and enlarging about the maturing fruit. *Fruit* a berry about an inch in diameter and enclosed within the calyx, the whole forming a spiny bur.

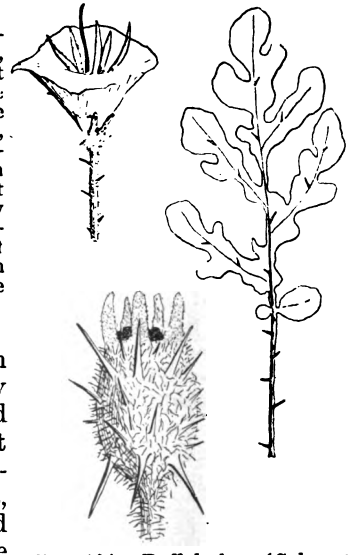

FIG. 104. Buffalo-bur (*Solanum rostratum*): Flower, fruit and leaf of Buffalo-bur, all natural size.

DISTRIBUTION.

Native of the Great Plains region from Nebraska to Texas and now rapidly spreading as a weed eastward; reported from San Diego County. An allied plant is the White Horse Nettle (*S. elaeagnifolium* Cav.) with blue or violet flowers, prickly stems, and narrow, wavy-margined leaves, all the herbage silvery due to the dense, scurf-like, hairy covering; fruit a yellow or orange berry scarcely ½ inch in diameter and not enclosed by the persistent calyx. The White Horse Nettle is a native of the western United States from Missouri to Arizona and introduced into California locally (Salinas Valley, Madera County, Imperial Valley).

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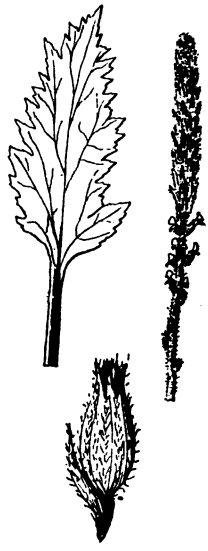

FIG. 105. Common Vervain (*Verbena prostrata*): Leaf, x 1. Spike, x 1. Fruiting calyx, x 16; the four nutlets are concealed within.

COMMON VERVAIN.

(*Verbena prostrata* R. Br.)

[FAM. Verbenaceae—Vervain Family.]

DESCRIPTION.

Habit: Perennial herb with spreading and reclining stems, 1 to 3 feet long, freely branching toward their ends and bearing opposite leaves, the oblong or ovate blades, 1 to 2 inches in length, somewhat wedge-shaped at base above the leaf-stalk; leaf-margins jagged; venation prominent. *Herbage* grayish-green, soft-hairy or the hairs occasionally stiff and harsh. *Flowers* violet or blue, aggregated into dense spikes, several inches to a foot long, grouped in clusters at the ends of the stems. Single flower small, less than ⅛ inch long, the calyx and corolla each composed of 5 united segments, stamens 4 in two pairs, and pistil solitary, its ovary becoming in fruit divided into four 1-seeded nutlets which are hidden within the persistent calyx.

DISTRIBUTION.

Common Vervain occurs on the drier hillsides and lowlands throughout the coast region of the state, flowering in mid-summer and setting abundant fruit. It may become a nuisance in pasture lots and require grubbing out before the nutlets ripen.

HOREHOUND.

(*Marrubium vulgare* L.)

[FAM. Labiatae—Mint Family.]

DESCRIPTION.

Habit: Perennial half-woody herb, evergreen in California, with a large root-system of tough, fibrous roots, from which arise tufts of white-woolly stems, generally unbranched, 8 inches to 2.5 feet high and conspicuously 4-angled. *Leaves* opposite, roundish or ovate, 1 to 2 inches long, with wrinkled surface, dark green above and cottony below, the margins shallowly scalloped; leaf-stalks shorter than the blades. *Herbage* intensely bitter. *Flowers* small, white, grouped in dense, half-rounded clusters in the leaf-axils, each flower with a spiny-tipped calyx and 2-lipped corolla, the upper lip 2-lobed, the lower 3-lobed with the middle lobe much the larger. Stamens 4, included by the corolla. Pistil and style 1. *Ovary* 4-lobed, each lobe developing into a 1-seeded nutlet.

DISTRIBUTION.

Horehound is one of the commonest weeds in the state and has spread far and wide from its original place of introduction along the seaboard. This spread has been due for the most part to the fact that the nutlets mature within the persistent calyx and the spiny, recurved teeth of the latter become fastened to the coats of animals, especially the fleeces of sheep, with consequent transport as the animals are herded from place to place. One finds this Old World immigrant even in remote mountain pastures where few other introduced plants have yet arrived.

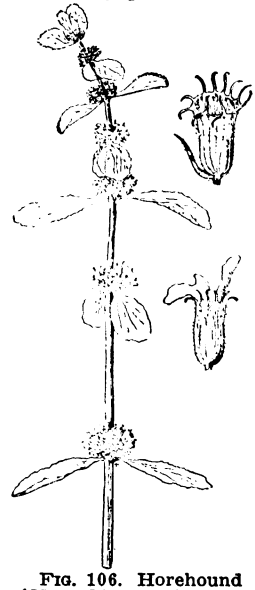

FIG. 106. Horehound (*Marrubium vulgare*): Left, top of a flowering stem, x 1, showing the dense flower clusters in the leaf-axils. Right, above, fruiting calyx, x 4, showing the woody, recurved teeth at its summit; below, flower, x 4; the position of the flower is naturally approximately horizontal.

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BEACH-BUR.

(*Franseria bipinnatifida* Nutt.)

[FAM. Compositae—Sunflower Family.]

DESCRIPTION.

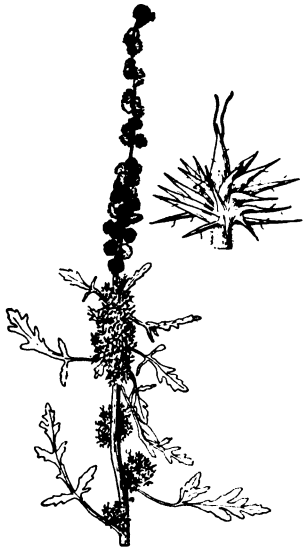

FIG. 107. Beach-bur (*Franseria bipinnatifida*): Upper part of a stem, x 1, showing the small staminate heads above and the clusters of burs below in the leaf-axils. Single bur, x 6, containing 2 flowers.

Habit: Seashore perennial weed, the herbaceous stems 2 to 3 feet long, somewhat hairy, spreading in all directions from the crown of the large, fleshy root, and bearing alternate, gray-green, soft-hairy leaves, 1 to 4 inches long, the blades divided nearly to the midrib (pinnatifid leaves) into narrow lobes which are irregularly margined or themselves deeply divided. *Flowers* of two sorts, staminate and pistillate, each in separate, small, greenish heads, the staminate heads in spikes or racemes at the ends of the stems; the pistillate heads solitary or in small clusters in the axils of the upper leaves, each with spiny, bur-like involucres enclosing 1 to 4 flowers.

DISTRIBUTION.

The Beach-bur may be found on any of the sandy beaches from Del Norte to San Diego, its burs a frequent source of woe to heedless bathers. Inland is found a nearly allied annual weed, *Franseria acanthicarpa*, much resembling the Beach-bur but with staminate heads only about half as large and the spines of the burs thinner than those of the seashore plant. This inland species is common everywhere on the dry, sandy floors of the interior valleys, growing at times so abundantly as to exclude other plants.

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DARNEL.

(*Lolium temulentum* L.)

[FAM. Gramineae—Grass Family.]

DESCRIPTION.

Habit: Annual grass with stout, erect, smooth culms, 1 to 3 feet high, bearing 5 to 7 leaves; leaf-blade 3 to 8 inches long and about ⅛ inch wide, smooth on the under surface but somewhat roughened above, their sheaths generally somewhat overlapping, smooth on the outside. *Flowers* in spikelets which are arranged on alternate sides of simple spikes, the last 4 to 8 inches long; the separate spikelets much flattened and placed edgewise to the axis of the spike. Spikelets with only one empty scale (glume) at base except the terminal spikelet, each containing 5 to 7 flowers, the flowering scales (lemmas) tipped with awns about ¼ inch in length. *Grain* brown, slender and deeply grooved on one side, resembling somewhat a grain of wheat.

FIG. 108. Darnel (*Lolium temulentum*): Left, spike of Darnel showing alternate arrangement of spikelets, x 1. Right, part of a spike, x 4, showing the curving axis and four spikelets; note the long glumes. Center, leaf, x ½.

DISTRIBUTION.

Darnel (often called Poison Darnel) is a European grass long ago introduced into California and now found from one end of the state to the other as a weed of grainfields, pastures, or waste lands. It is closely allied to Italian Rye-grass (*L. multiflorum*) and to English Rye-grass (*L. perenne*), both perennial grasses of large forage value, the first rather common in California and distinguished from Darnel by the glume being shorter than the spikelet; in Darnel this glume is as long and frequently longer than the spikelet.

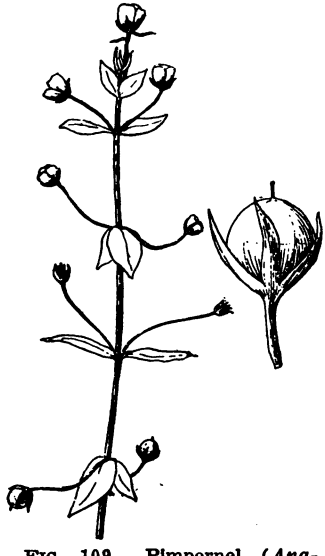

FIG. 109. Pimpernel (*Anagallis arvensis*): End of a stem bearing flowers above and fruits below, x 1. Fruit enclosed within the persisting calyx and tipped by the withered style, x 8.

PIMPERNEL.

(*Anagallis arvensis* L.)

[FAM. Primulaceae—Primrose Family.]

DESCRIPTION.

Habit: Low spreading, annual herb, the many stems much branched, the branchlets 4-sided. *Leaves* about ⅛ inch long, oval or pointed, thin and light green, usually opposite but occasionally in whorls of 3, the under-surface often black-dotted; no leaf-stalks. *Flowers* salmon-colored or brick-red, borne singly in the leaf-axils on long, thread-like flower-stalks; each flower formed of 5 sepals and as many petals and stamens, the globular *ovary* of the single pistil ripening into a round capsule which splits open around the middle, the upper half coming off like a lid and freeing the many triangular, pitted seeds.

DISTRIBUTION.

The flowers of Pimpernel quickly close in threatening weather and this behavior has given origin to another common name by which the plant is often known—Poor Man's Weather-glass. Pimpernel is a native of the Old World which is now found everywhere in the coast region of California, flowering nearly throughout the year.

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WOAD.

(*Isatis tinctoria* L.)

[FAM. Cruciferae—Mustard Family.]

DESCRIPTION.

Habit: Biennial herb with smooth, simple or branching stems, 1 to 3 feet high, bearing obtuse blue-green leaves, 1 to 2 inches long, their margins entire or nearly so, the blade prominently nerved; lower leaves tapering at base to a leaf-stalk about ¼ as long as the blade, the upper leaves directly attached to the stem by clasping bases. *Flowers* in simple branched clusters (racemes) at the top of the stems, each flower composed of 4 sepals about half as long as the equally numerous yellow petals; stamens 6 and pistil 1. *Ovary* becoming a short, flattened pod, oval in shape, about ½ inch in length and half as wide, 1-celled and usually 1-seeded, with a conspicuous wing all around. Pod not opening at maturity (indehiscent).

DISTRIBUTION.

Woad is a European weed recently introduced into California. In Utah it has become a serious pest in grainfields and gardens.

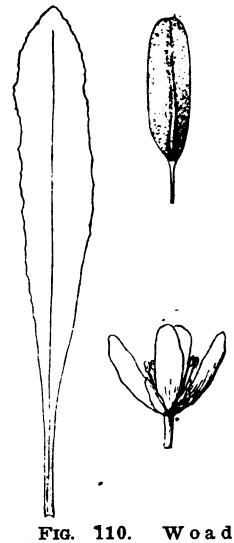

FIG. 110. Woad (*Isatis tinctoria*): Leaf, x ½. Flower, x 3.

SOUR CLOVER, BITTER CLOVER.

(*Melilotus indica* Allioni)

[FAM. Leguminosae—Bean Family.]

FIG. 111. Sour Clover (*Melilotus indica*): Top of a flowering stem of sour clover showing leaf character and racemes of flowers, x 1. Pod, x 12.

DESCRIPTION.

Habit: Annual glabrous herb with erect, slender, freely branching stems 1 to 4 feet high or higher on the richest soils, the stems somewhat succulent at first but becoming tough and fibrous. *Leaves* 3-foliate, each leaflet with a short stalk at base and somewhat wedge-shaped, the free tip squarrish or notched and margins finely toothed above the middle; leaflet about ½ to 1 inch long. Herbage fragrant in drying. *Flowers* pea-shaped, small (⅛ inch long), yellow, grouped in terminal clusters (racemes) which are 1 to 2 inches long; the corolla soon falling away from the calyx which remains at the base of the wrinkled 2-seeded pod.

DISTRIBUTION.

Sour Clover, a native of the Old World, is common in damp ground throughout California and has been used as a green manure crop in the citrus groves of the southern part of the state. A closely allied plant is Sweet Clover (*M. alba* Lam.), with longer sprays of small, white flowers, the herbage lacking the intensely bitter taste of that of Sour Clover. Sweet Clover is a valuable forage plant, especially for sandy lands, readily eaten by cattle accustomed to its slightly bitter taste.

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FIG. 112. Western Ragweed (*Ambrosia psilostachya*): Top of stem showing several racemes of heads, each growing from a leaf-axil, x 1. Single leaf, x 1. Single staminate head (drawn in reversed position), x 8; note the bracts of the involucre united to form an open cup about the flowers.

WESTERN RAGWEED.

(*Ambrosia psilostachya* DC.)

[FAM. Compositae—Sunflower Family.]

DESCRIPTION.

Habit: Coarse perennial herb with simple stems, 2 to 3 or 4 feet high, growing erect from slender, running rootstocks and bearing alternate, deeply-lobed (pinnatifid) leaves, 2 to 5 inches long. Herbage harsh with short, stiff hairs, gray-green in color and aromatic when rubbed. *Flowers* greenish, of two sorts, staminate and pistillate, each kind in separate, small heads borne on the same plant (monoecious). Staminate heads numerous, nodding, containing several flowers, and clustered in erect, spike-like racemes; pistillate heads few or solitary at the base of the staminate racemes, each single flowered, their involucres developing into a short and thick, spine-tipped bur having a row of prickles near its summit and enclosing the single, small, oily fruit (achene).

DISTRIBUTION.

This is one of the commonest weeds of roadsides, railway reservations, and neglected land generally, especially land subject to overflow in spring. Ragweed flowers in late summer and fall and the abundant pollen, produced in the many staminate heads, has been shown to be in some cases the cause of hay-fever.

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SHEPHERD'S PURSE.

(*Capsella bursa-pastoris* L.)

[FAM. Cruciferae—Mustard Family.]

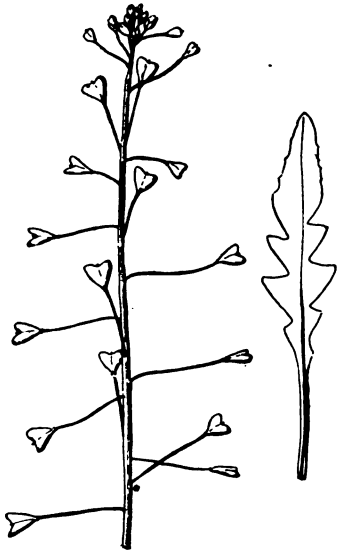

FIG. 113. Shepherd's Purse (*Capsella bursa-pastoris*): Summit of a flowering and fruiting stem, x 1. Basal leaf showing the lobed blade and leaf-stalk, x 1.

DESCRIPTION.

Habit: Abundant annual spring weed of gardens, vineyards and orchards with stems 6 inches to 1.5 feet high, rarely branching and sparingly hairy. *Basal leaves* 2 to 5 inches long, more or less deeply lobed and forming a rosette from the center of which the stem, with its few merely toothed or entire sessile and clasping leaves and terminal clusters of flowers and fruits rises. *Flowers* small, white, the petals 1/16 inch long and 4 in number, exceeding the minute sepals; flowers borne on slender flower-stalks that spread widely from the stem or become bent down in fruit. *Fruit* a pod, wedge-shaped and flattened, notched at the free end and containing about a dozen orange-colored seeds in each of its 2 cells. Seeds with a pair of grooves lengthwise on each side.

DISTRIBUTION.

Everyone knows this extremely common tenant of cultivated ground in which it often grows so rankly as to choke out all other herbs. Under certain conditions it is attacked by a fungus which causes ivory-white swellings to form on the upper part of the stem and on the fruits; this disease may appear upon cabbage and other plants belonging to the Mustard Family.

COMMON RUE.

(*Ruta graveolens* L.)

[FAM. Rutaceae—Rue Family.]

DESCRIPTION.

Habit: Half-woody herbaceous, heavy-scented, perennial plant with smooth, glaucous stems a foot or two in height bearing alternate, thickish, deeply-cut leaves (pinnatifid), the leaf-segments club-shaped; leaf-surface dotted with pellucid glands and containing abundant volatile oil, therefore the herbage fragrant when bruised. *Flowers* yellow, about ½ inch across, the petals with uneven margins and tips inrolled; stamens unequal in length, twice as many as the petals. *Ovary* single, developing into a deeply-lobed capsule which ruptures at the summit to free the numerous small seeds.

DISTRIBUTION.

Common Rue (also called Herb of Grace), an Old World "simple" formerly much used in medicine and still esteemed in household doctoring, is now established as an escape from cultivation about some of the older settlements in California (San Diego, Monterey). It belongs to the same family as the citrus fruits.

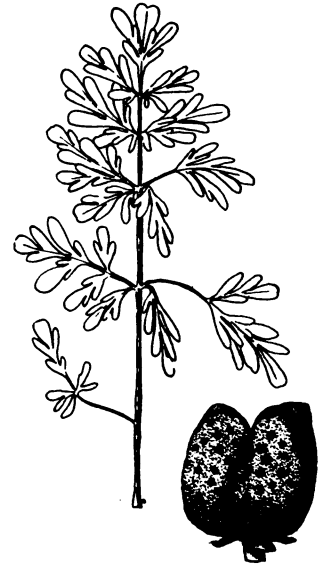

FIG. 114. Common Rue (*Ruta graveolens*): Leaf, x 1. Fruit, x 6; note the 4 (sometimes 5) lobes.

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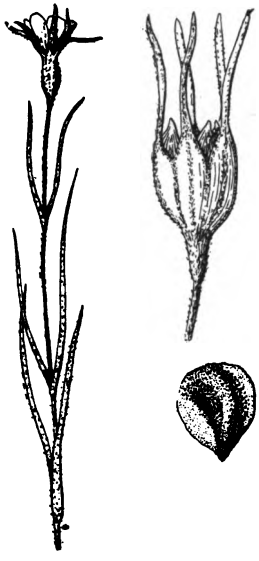

FIG. 115. Corn Cockle (*Agrostemma githago*): Flower, x ½. Capsule, x 1. Seed, x 4.

CORN COCKLE.

(*Agrostemma githago* L.)

[FAM. Caryophyllaceae—Pink Family.]

DESCRIPTION.

Habit: Annual herb with white-hairy stems 1.5 to 3 feet high, sparingly branched near the top, joints of the stems enlarged. *Leaves* opposite, unstalked, 2 to 4 inches long and ¼ inch wide or less, narrowing above to the pointed tip. *Flowers* few, showy, long-stalked, the 5 sepals united below to a strongly 10-ribbed tube but their tips prolonged as conspicuous green lobes longer than the petals; corolla dark purplish-red, flaring, 1 to 2 inches across, composed of 5 free petals, each with a narrow basal claw and expanded spreading limb, somewhat black-dotted; stamens 10. *Ovary* solitary, ripening to a 1-celled erect capsule about ½ inch long, containing numerous dark brown to blackish wedge-shaped seeds, their surfaces covered with curving rows of small teeth.

DISTRIBUTION.

Grainfield weed of European origin first noticed in California some thirty years ago and now established at several places in the Great Valley (Sutter County) and in the valleys of the Coast Range (St. Helena, Live Oaks).

ARROW-WEED.

(*Pluchea sericea* Coville)

[FAM. Compositae—Sunflower Family.]

DESCRIPTION.

Habit: Tall, willow-like shrub, the slender, leafy stems rising 5 to 10 or even 15 feet in height and bearing alternate, silvery-silky, unstalked leaves, ½ to 2 inches long and ¼ inch wide, their margins entire and tapering to both ends. *Flowers* in numerous small heads clustered at the ends of the branches, each head enclosed at base by an involucre of numerous bracts, the outer bracts brown or purplish tinged and leathery in texture, the inner ones thin and white, longer than the outer series and soon falling away; no ray-flowers, all the corollas whitish or tinged with purple or red. Achenes small, 4 to 5-angled and crowned with a pappus consisting of a single series of slender, rough bristles.

DISTRIBUTION.

The Arrow-weed is becoming a nuisance along irrigating ditches in the Imperial Valley and elsewhere in the newly irrigated districts of southern California, the plants often forming veritable cane-brakes impossible to penetrate and requiring grubbing with heavy hoe or mattock to keep within bounds.

FIG. 116. Arrow-weed (*Pluchea sericea*): End of a stem showing leaf shape and position of the heads, x 1. Single head, x 6.

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GROUP III

MISCELLANEOUS WEEDS

By F. J. SMILEY, Collaborator.

QUACK-GRASS OR COUCH-GRASS.

(*Agropyron repens* Beauv.)

DESCRIPTION.

Habit: European immigrant grass with culms 1 to 3.5 feet high rising from creeping, jointed, scaly rootstocks; the latter bright yellow-green. *Leaf-blades* 2 to 6 inches long, thin and flat, slightly rough-hairy on the upper side; leaf-sheaths shorter than the internodes, smooth. *Flowers* in flattened spikelets, placed with one flat side to the axis of the spike which is 2 to 8 inches long; spikelet containing about 5 flowers, each with pointed or awned scales.

DISTRIBUTION.

Couch-grass in California is now chiefly a nuisance in gardens and orchards in the Bay Region, but is slowly increasing its area of occupation and will in time doubtless become distributed throughout the state. Spreading is achieved mainly by the rootstocks, each joint of which under favorable conditions may produce a new plant. This grass is a good "soil-binder," its widely spreading and finely branching rootstocks holding the soil firmly against wind and water.

STINK-GRASS.

(*Eragrostis cilianensis* Link)

DESCRIPTION.

Habit: Annual grass with branching, smooth stems rising ½ to 2 feet high, bearing leaves with blades 3 to 8 inches long, roughened on the upper side but smooth beneath, their sheaths smooth. *Flowers* in flattened spikelets, each containing from one dozen to three dozen or more flowers, the spikelets grouped in terminal spreading panicles 2 to 8 inches long and dull gray-green in color; scales of the spikelets pointed but not awned, the flowering scales (lemmas) glandular-dotted.

DISTRIBUTION.

Stink-grass is an Old World immigrant now widely spread in all parts of the United States and found in California from the San Joaquin Valley southward. About Los Angeles it is becoming fairly common along ditches and streams. The grass is a handsome species but is ill-scented and rejected by animals.

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NIT-GRASS.

(*Gastridium lendigerum* Gaud.)

DESCRIPTION.

Habit: European annual grass, the many tufted, smooth stems rising about a foot high or a little higher in moist ground. *Leaves* with flat, light green blades, 2 to 6 inches long, rough on both sides and tapering to long points; leaf-sheaths shorter than the internodes. *Flowers* in spikelets, each 1-flowered, grouped in dense, bristly, spike-like panicles, 2 to 6 inches long, the panicles pale green and shining.

DISTRIBUTION.

Nit-grass is now fairly common in the coast counties of the state, growing along neglected roadsides or spreading over the dried slopes of the lower mountains. Though not especially relished by stock, it may be of some value as summer forage on the ranges, since it is one of the latest grasses to appear in spring.

WALK-GRASS.

(*Poa annua* L.)

DESCRIPTION.

Habit: Old World introduced annual grass with slender, light-green stems a foot or less in height, usually bent at the base and often rooting at the lower joints. *Leaves* soft and weak, about 3 inches long, smooth on both sides, their sheaths loosely enveloping the stem-joints. *Flowers* in spikelets containing 3 to 6 flowers, the spikelets grouped in terminal panicles, which are often more or less one-sided and 1 to 4 inches in length.

DISTRIBUTION.

Walk-grass is a frequent intruder in lawns or may be sowed as an impurity in the "lawn mixture" used for seeding, later giving rise to unsightly spots when it has completed its short period of growth. This grass is widely distributed in California, being found in moist soil from one end of the state to the other. The name, Walk-grass, indicates a common place for it to develop and where it is often difficult to eradicate.

CYPSELEA.

(*Cypselea humifusa* Turp.)

DESCRIPTION.

Habit: Small, prostrate, annual herb, the branching stems forming mats 1 to 2 inches across. *Leaves* opposite, blunt, oval in outline, $\frac{1}{8}$ to $\frac{1}{3}$ inch long, borne on leaf-stalks about as long as the blade, the members of each pair of leaves unequal in size with the smaller having a short stem in its axil, this branch bearing numerous crowded leaves and a single-stalked flower. *Flower* without petals, green, composed of 5 sepals united at base into a short tube and enclosing 1 to 3 stamens and a single, central, 1-celled ovary, the latter surmounted by a 2-cleft style. *Fruit* a rounded capsule which splits open at maturity about its middle exposing the numerous minute, smooth seeds.

DISTRIBUTION.

Native of the West Indies, long ago introduced into the Delta Region of central California (near Lathrop) and at one or two other places along the coast (Santa Cruz): not apparently spreading.

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RED MAIDS OR KISSES.

(*Calandrinia caulescens* var. *menziesii* Gray)

DESCRIPTION.

Habit: Slightly fleshy, annual herb blooming in early spring, the usually simple spreading or ascending stems ½ to 1 foot in length, bearing alternate, entire leaves and crimson flowers. *Leaves* narrowly strap-shaped or somewhat broadened below the pointed tip, 2 inches or less in length and tapering to the base. *Flowers* in a simple leafy raceme, each flower borne on an erect flower-stalk and composed of 2 persistent sepals, 5 red petals of rounded shape but notched at the top, each ¼ to ½ inch long, 10 or 12 stamens, and a single central ovary, the latter tipped with a 3-branched style. *Ovary* ripening to a short-pointed, oval capsule enclosed between the sepals which remain after the petals have fallen; seeds numerous, black and shining.

DISTRIBUTION.

Few plants are more typical of the spring flora of California's coast than Red Maids, their rose-red flowers dotting the pastures or blooming upon the hills and mesas from Oregon to San Diego during the months from February to May. In lowlying ground the growth is specially rank, the stems attaining two or three times their usual length.

MINER'S LETTUCE OR SQUAW CABBAGE.

(*Montia perfoliata* Howell)

DESCRIPTION.

Habit: Juicy, succulent, spring herb, completely glabrous, the stems rising ½ to 1 foot high, two or three times as long as the numerous basal leaves. *Foliage* of two kinds of leaves: radical or basal leaves, ½ to 3 inches long, narrowly scarp-shaped or broader above, each long-stalked; stem-leaves opposite, semi-circular in shape, completely united by their adjacent bases forming a rounded disk through which the stem appears to protrude. *Flowers* small, grouped in terminal racemes or sometimes bunched in a dense cluster in the center of the leaf-disk, each flower formed of 2 green sepals, 5 white or flesh-colored petals larger than the sepals, 5 stamens, and a single ovary. *Ovary* becoming a capsule which splits downward from the apex to free the several small, black, shining seeds, each with a finely granular seed-coat.

DISTRIBUTION.

Miner's Lettuce is too common a weed to need much characterization to most Californians; it grows abundantly in orchards, vineyards, and gardens, or farther afield on lowlying pastures and in the shade of trees and hedges. It has some value as a green manure plant if turned under about the time of flowering. The name Miner's Lettuce harks back to the pioneer days of California when salad plants were scarce and recourse taken to the native herbs as a means of varying the daily menu.

CORN SPURRY.

(*Spergula arvensis* L.)

DESCRIPTION.

Habit: European immigrant, annual weed with small, white flowers and leaves appearing as if in whorls, the several stems freely branched at the base, each 1 to 2 feet long, conspicuously jointed and more or less glandular-hairy. *Leaves* somewhat fleshy, narrowly linear or awl-like, ½ to 1.5 inches long, really opposite but appearing whorled because of several whorls being closely crowded together. *Flowers* small, white, opening only in the sunlight, about ¼ inch broad, formed of 5 green sepals and as many petals, the stamens 10 or (less often) 5 in number, and single ovary, the latter surmounted by 5 styles; all the flowers grouped in a spreading cluster,

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its slender branches becoming reflexed after flowering. *Fruit* a capsule containing many minute seeds, each somewhat flattened, dull black but margined by a light-colored wing.

DISTRIBUTION.

This is a weed of fields, orchards and kitchen gardens, which under right conditions may quickly overrun its more desirable associates. According to Professor Jepson, cattle eat it readily and he reports that it is said to increase the flow of milk.

CALIFORNIA POPPY.

(*Eschscholtzia californica* Cham.)

DESCRIPTION.

Habit: Glabrous herb with bitter juice, finely divided leaves, and orange or yellow flowers, the thick roots living for a year or two and becoming a foot or more in length. *Stems* annual, branching at the base, 1 to 2 feet high. *Basal leaves* large, grayish-green, compound, the ultimate segments very narrow or oblong; stem leaves much smaller, very shortly stalked or nearly sessile. *Flowers* large, 2 to 4 inches across, composed of 2 sepals united into a single caplike calyx (calyptra) which is pushed off by the expanding corolla, 4 large, rounded petals, numerous stamens with prominent yellow anthers, and a single central, slender ovary, 1 to 4 inches long, which ripens to an elongated 10-nerved capsule containing many round seeds, dark brown or blackish in color, their seed-coats marked by small tubercles.

DISTRIBUTION.

Extremely abundant and known to all Californians as one of the floral gems of the state, growing indifferently in all soils and in flower almost throughout the year, though the largest blooms and most beautiful colors are developed in spring. Very variable in size and character of growth, some of the forms having been described as distinct species but the distinguishing characters difficult to define or confirm.

WORMSEED MUSTARD.

(*Tropidocarpum gracile* Hooker)

DESCRIPTION.

Habit: Slender, erect or freely-branching and spreading annual plant with hairy herbage, deeply lobed leaves, and small, yellow flowers grouped in leafy racemes. *Stems* 8 to 16 inches high, more or less hairy, bearing pinnatifid leaves 2 to 4 inches long, the lobes linear and entire or less often cleft, the upper leaves smaller than the lower but otherwise similar. *Flowers* on flower stalks an inch or less in length, each flower composed of 4 sepals in opposite pairs, as many petals, 6 stamens (4 long and 2 short), and a central ovary which ripens to a slender, 2-celled pod (silique) that at maturity is flattened or somewhat twisted and contains many small, brownish seeds arranged in 2 rows in each cell.

DISTRIBUTION.

Wormseed Mustard has become a grainfield weed of some consequence in the San Joaquin Valley from Fresno southward and is a common member of the spring flora of southern California.

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KIT-KIT-DIZZE OR BEAR CLOVER.

(*Chamaebatia foliolosa* Bentham)

DESCRIPTION.

Habit: Low spreading shrub, the freely branching stems rising 6 inches to 1 foot in height and bearing dark green leaves ½ to 4 inches long, each leaf finely divided into many minute crowded lobes. *Herbage* more or less resinous and strongly scented. *Flowers* white, about ½ inch broad, aggregated into flat-topped clusters at the ends of the stem branches, each flower composed of 5 sepals and as many petals, numerous stamens, and a single pistil, the latter becoming a dry one-seeded leathery fruit (achene).

DISTRIBUTION.

This is one of the commonest plants found growing upon the slopes of the Sierra Nevada, just below and in the Yellow Pine belt. It is here included not because it can justly be termed a "weed" but because it justly deserves consideration in any description of the plants found growing along roads or trails: one can not visit the finest vacation ground of the state, the higher Sierra, without crossing the zone wherein this pretty shrub abounds.

FILAREE OR STORKSBILL.

(*Erodium* sp.)

DESCRIPTION.

Habit: Annual herb with erect, straggling, or procumbent stems bearing deep-green simple lobed or compound leaves and white, purplish, or violet flowers. *Herbage* usually more or less hairy and sometimes fleshy. *Flowers* complete regular symmetrical, composed of 5 persistent sepals and as many petals, the latter falling soon after flowering; stamens with anthers 5 with sterile scales in between; pistil composed of 5 parts, each with its style, all the styles united about a central stalk except just at their tips. *Fruit* becoming divided into 5 one-seeded parts, each with its persistent style developed as a twisted hairy tail that coils when moistened.

DISTRIBUTION.

Our present flora contains three species of *Erodium* generally known as filaree, all of considerable forage value. They were long ago introduced into the state in the wake of the Mission Fathers and are now so completely naturalized that few people suspect their Mediterranean origin. These plants may be distinguished by the following key:

Key to the Weedy Erodiums.

Leaves simple but deeply lobed (i. e., not composed of separate leaflets); petals deep violet; beak of the fruit 3 inches or longer----------(1) *E. botrys*
Leaves compound (i. e., composed of separate leaflets); petals rose-purple; beak of the fruit not exceeding 2 inches in length.
  Leaflets merely toothed; stems generally whitish; herbage prominently glandular----------(2) *E. moschatum*
  Leaflets pinnatifid (deeply lobed); stems generally reddish; herbage slightly glandular----------(3) *E. cicutarium*

The second species is commonly known as White-stemmed Filaree, also as Musk Clover; *E. cicutarium* is called Red-stem Filaree. The name filaree is derived from the Spanish alfilerilla (= little pin), referring to the pin-like shape of the fruits. Both species are occasionally spoken of as Pin Clovers or Pin Grasses.

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SPOTTED SPURGE OR MILK PURSLANE.

(*Euphorbia maculata* L.)

DESCRIPTION.

Habit: Annual dark green herb with milky juice, the stem branching from the base, the slender branches widely spreading and more or less prostrate, often colored dark red. *Leaves* opposite, oblong, ½ inch or less in length, with toothed margins and heart-shaped base, usually blotched with red above, very shortly stalked. *Herbage* hairy. *Flowers* reduced and aggregated within an involucre, the whole simulating a single flower, the 4 spreading white glands looking like small petals. *Ovary* becoming a 3-lobed rounded capsule about 1/12 inch in diameter, each lobe containing a single wrinkled and pitted reddish seed.

DISTRIBUTION.

This spurge is still rare in California, though introduced long ago on the Pacific Coast from the eastern United States. If it becomes too abundant, hand hoeing or pulling will keep it within bounds.

The weed flora of California contains several other spurges, one of which, the common Turkey Mullein, is figured on page 51; other weedy species occurring more or less commonly about gardens, greenhouses, or neglected city lots include the following:

(1) Caper Spurge or Mole Plant (*E. lathyrus* L.), also called "Gopher Plant"—a tall stout annual or biennial, 1 to 4 feet high, with very smooth glaucous stems and opposite leaves either very narrow (linear), thickish, and arranged in 4 vertical rows upon the stems, or broader with heart-shaped bases, the latter kind found among the "flowers," which are grouped in terminal umbels, each "flower" (really a group of reduced flowers) with crescent-shaped glands, large smooth capsule, and wrinkled seeds: Native of the Mediterranean region.

(2) Petty Spurge or Devil's Milk (*E. peplus* L.), glabrous annual 4 inches to 1 foot high, the slender yellow-green stem simple or branched above; lower leaves alternate, broadening to the rounded tip, ½ to 1 inch long, upper leaves oval and bluntly pointed, the foliage more or less crisped or wrinkled; "flowers" in terminal umbels, yellow-green, the 4 glands crescent-shaped and long-horned; capsule globose, green, containing 3 ash-colored, oblong, pitted seeds. Especially common about greenhouses or shady damp spots in gardens.

(3) Thyme-leaved Spurge (*E. serpyllifolia* Pers.), glabrous dark green annual herb, often reddish in age, with branching prostrate stems or these sometimes ascending, a foot or less in length; leaves broader above and more or less finely toothed above the middle or entire, often with a red spot on the upper surface; "flowers" borne in lateral leafy clusters, the glands small and capsule containing 3 minute shapely, 4-angled, faintly wrinkled seeds. Native of western North America and abundant along streams and in low damp ground (especially about ponds) in the Coast Range and Great Valley, southward to Mexico.

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BLUE CURLS OR VINEGAR WEED.

(*Trichostema lanceolatum* Benth.)

DESCRIPTION.

Habit: Annual gray-hairy glandular strong-scented herb with simple or basally branching leafy stem, ½ to 1 foot high, the opposite entire leaves about 1 inch long, narrow and pointed, unstalked, with prominent parallel veins. *Flowers* composed of a calyx formed of 5 sepals united for about half their length, 2-lipped blue or lavender corolla with very slender tube and curling free tips to the 5 petals, 4 long-protruding stamens which curve outward and downward from beneath the upper lip of the corolla, and a single central ovary with long thread-like style, the ovary ripening into 4 one-seeded nutlets with wrinkled coats.

DISTRIBUTION.

This very common native plant (also known as Camphor Weed) is found growing upon the dry hills or stubblefields from June to September throughout central and southern California. In the San Joaquin Valley it is a valued bee plant. Three other species are found within the state: (1) *T. laxum* (Turpentine Weed), differing from the above in its sparsely leafy stems and stalked leaves, a summer bloomer of northern central California; (2) *T. lanatum*, the famous "Romero," a half-shrubby plant rising 2 to 3 feet with long spikes of woolly flowers and growing in the chaparral of southern California; (3) *T. oblongum*, the "Turpentine Weed" of the Sierra Nevada foothills.

NECKWEED OR PURSLANE SPEEDWELL.

(*Veronica peregrina* L.)

DESCRIPTION.

Habit: Annual small herb less than 12 inches high, erect or branched from the ground. *Herbage* finely hairy and somewhat glandular. *Leaves* alternate or the lowermost opposite, an inch or less long, entire or toothed, mostly unstalked, either blunt or the upper sharply pointed and longer than the small, whitish flowers which are found in the upper leaf axils. *Flower* 4-parted with 2 stamens and single ovary, the latter becoming a rounded capsule, flattened, and notched at the free end, containing many minute yellow seeds.

DISTRIBUTION.

Common in low land or about the dry beds of winter ponds in central and southern California.

CHICORY.

(*Cichorium intybus* L.)

DESCRIPTION.

Habit: Perennial herb with branched stem, mainly basal leaves, and blue or whitish flowers. Erect stem growing from a deep tap-root, becoming 2 to 4 feet high, stem leaves reduced in size and bract-like. *Basal leaves* spreading, 3 to 7 inches long and about an inch wide, their margins irregularly toothed or sometimes deeply incised; the upper leaves entire, clasping the stem by broad bases. *Flowers* in unstalked heads about an inch broad, grouped in clusters of 1 to 4 along the nearly naked stem branches. Heads enclosed at base by an involucre of green bracts arranged in two series, the outer shorter and spreading, the inner longer and erect. Flowers all alike in shape but the outer corollas larger and spreading ray-like about the smaller central corollas. Heads generally closing about noon.

DISTRIBUTION.

Old World immigrant found about waste grounds adjacent to the older settlements, the ground-up root used as a substitute or adulterant for coffee.

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PINEAPPLE WEED.

(*Matricaria suaveolens* Buch.)

DESCRIPTION.

Habit: Low annual glabrous herb with pinnately dissected green leaves, the much-branched leafy stem rising a foot high or usually less, often more or less reclining. *Herbage* sweet-scented, the odor of the bruised foliage suggesting the common name. *Flowers* greenish-yellow, grouped in long-stalked rayless small heads, the center of the head conspicuously conical, surrounded at base by an involucre composed of yellow-green bracts with papery (scarious) margins.

DISTRIBUTION.

Abundant about old farmyards, along roadsides, and also in old pastures throughout the state, flowering in late spring and early summer (April-July).

A nearly allied plant is *M. occidentalis*, with larger heads and herbage less strongly scented: a weed of good soil ranging from central California (Tehama County) southward.

WATER-GRASS OR COLORADO DITCH-GRASS.

(*Leptochloa imbricata* Thurber)

DESCRIPTION.

Habit: Annual tall grass of wet or swampy land with smooth culms rising 1 to 2 feet erect and branched or sometimes occurring as a dwarf scarcely 6 inches high; leaf-blades 2 to 8 inches long, narrow and roughened, the leaf-sheaths smooth, shorter than the internodes. *Flowers* in spikelets grouped in numerous (20 to 40) spikes each 1 to 4 inches long, slender and purplish, the spikes spreading from a main axis, their sessile spikelets distant from each other and all placed on one side of the axis of the spike; spikelets generally 7 to 8 flowered, the florets without awns.

DISTRIBUTION.

Water-grass is becoming a nuisance in Imperial Valley along irrigating ditches or as an intruder in truck gardens; it is difficult to exclude, the grains being carried by the water from the main ditches.

Another species, *L. fascicularis* Gray, very similar to the above but with the flowering scales (lemmas) tipped with short awns, is causing some trouble in the San Joaquin Valley, again as a fouler of irrigating channels; this species grows rankly on alkaline ground.

YARD RUSH.

(*Juncus tenuis* Willd.)

DESCRIPTION.

Habit: Perennial with wiry tufted deep green stems, 2 inches to 2 feet high, forming dense clumps and spreading by underground rootstocks. *Leaves* mainly basal, grass-like and narrow, the round slender stems nearly naked above, leaf-sheaths with broad paper margins. *Flowers* pale greenish, small, mostly bunched at the tips of the stem branches, the whole flower group (inflorescence) overtopped by the uppermost leaf; single flower composed of 6 sharp-pointed pale green bracts surrounding the 6 stamens and central egg-shaped capsule which matures many small brown seeds, each with the exterior marked by ribs and cross lines.

DISTRIBUTION.

Very common in moist or dry soil, especially along paths and roadsides, or in fields and gardens; difficult to eradicate.

Other weedy rushes include Toad Rush (*J. bufonius* L.) and Common or Soft Rush (*J. effusus* L.), the former exceedingly common in clayey soil, the latter growing in swampy places and becoming 1 to 4 feet tall.

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COMMON CRANESBILL.

(*Geranium dissectum* L.)

DESCRIPTION.

Habit: Annual hairy and glandular herb with forking reddish stems, swollen joints, palmately parted leaves, and rose-red flowers, the plants erect or, when large, sprawling over the ground, the stem ends rising ½ to 1 foot high. *Leaves* 1 to 2 inches wide, deeply cleft into narrow segments which radiate from the summit of the leaf-stalks, each segment broadening upward and usually 3-lobed at the end, the ultimate lobes sharply pointed. *Flowers* borne in umbels in the leaf-axils, each flower regular, 5-parted, the ten stamens divided into a longer and shorter alternating series. *Ovary* superior, 5-celled and deeply lobed, the 5 styles united about a central stalk, each lobe of the ovary becoming a one-seeded dry fruit (achene) tipped by the persistent style as a spirally coiled or twisted tail.

DISTRIBUTION.

European immigrant very common in gardens or along paths and roadsides in the Bay Region, apparently rapidly spreading. Flowering March to May.

Carolina Cranesbill (*G. carolinianum* L.) hardly differs from the above, except in the broader leaf-segments and light pink flowers; it is the more common form in southern California, flowering in the spring.

SMALL QUAKING-GRASS.

(*Briza minor* L.)

DESCRIPTION.

Habit: Annual low grass with erect smooth culms 4 to 16 inches high, bearing leaves with flat blades 1 to 4 inches long and ⅛ inch wide or less, sometimes roughened, their sheaths shorter than the internodes. *Flowers* in spikelets grouped in an open spreading panicle, its branches very slender or thread-like, permitting the slightly nodding spikelets to sway in the lightest breeze; spikelet 3-flowered, flattened and broadly heart-shaped, its scales papery margined.

DISTRIBUTION.

Small Quaking-grass is a native of Europe now naturalized in many parts of the world and found at home in California about San Francisco Bay and northward. A nearly related species is *B. maxima*, 1 to 2 feet tall with pendent spikelets half an inch long, a garden favorite sometimes found escaped; when the mature panicle of the grass is shaken, the spikelets rub together, giving a slight sibilant sound suggesting a common name applied to this larger species, that of Rattlesnake-grass.

NEEDLE-GRASS OR TRIPLE-AWNED-GRASS.

(*Aristida purpurea* Nutt.)

DESCRIPTION.

Habit: Perennial tufted glabrous grass with rather stout erect culms, 1 to 2 feet high and leaves with flat blades or these more often inrolled above, 2 to 6 inches long, their sheaths short. *Flowers* in spikelets grouped in a loose purplish panicle, 4 to 6 inches long, its branches very slender and more or less drooping, generally 3 to 5 branches at each joint; spikelet narrow, 1-flowered, its empty scales (glumes) very unequal, the second twice as long as the first, both short awned; flowering

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glume (lemma) purple, about ½ inch long, tipped with a 3-pronged awn, each prong about ½ inch in length.

DISTRIBUTION.

Needle-grass is one of a group of related grasses growing in the deserts and on the dry plains of the southwestern United States, of little forage value, especially after flowering, for then the rigid grains with their spreading rough awns become a danger to stock, penetrating eyes, nostrils and mouths, or working their way into the fleece of sheep. In California there are about ten species, all native except possibly one.

GNAWED CANARY-GRASS.

(*Phalaris paradoxa* L.)

DESCRIPTION.

Habit: Annual weedy grass of Mediterranean origin now naturalized at several places in the Sacramento and San Joaquin Valleys, also in the Coast Counties south of the Bay Region, with tufted erect stems, 1 to 2.5 feet high; flat leaves 3 to 8 inches long, rough on both sides and somewhat glaucous, their sheaths more or less inflated. *Flowers* in spikelets densely crowded in a terminal spike-like panicle about an inch or two long, the spikelets in groups of 7 (1 fertile spikelet surrounded by 6 sterile), each containing a single flower and flattened sidewise.

DISTRIBUTION.

This is a weed of grainfields rarely found beyond tilled land, but another Canary-grass (*P. minor* Retz.), with spikelets all alike and not arranged in distinct groups within the panicle, is an immigrant from South Europe which has successfully established itself on waste land and along roadsides, especially in heavy soils, throughout central and southern California; its panicle is handsome, the scales with dark green midribs and white margins.

FALSE FLAX OR DUTCH FLAX.

(*Camelina sativa* Crantz.)

DESCRIPTION.

Habit: Erect annual nearly glabrous herb with stem 1 to 2 feet high, simple or branched above, bearing numerous leaves, the lower stalked, 2 to 3 inches long, oblong or bluntly pointed, their margins entire or coarsely toothed, upper leaves mostly even-margined, smaller and attached to the stem by broad clasping bases. *Flowers* small, yellow, grouped in loose racemes, each flower composed of 4 sepals and as many petals, 6 stamens (4 long, 2 short), and a single central ovary which ripens to a pear-shaped pod slightly flattened and narrowly winged, about ¼ inch long, containing 2 cells and beaked with the withering persistent style; seeds many, yellowish.

DISTRIBUTION.

False Flax (so-called because of an old-time notion that it was produced as the result of degenerative change in true Flax) is a weed of grainfields in California, especially in the northern part of the state. The plant is cultivated to some extent in Europe, a fine oil being expressed from the seeds.

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COMMON VETCH OR TARE.

(*Vicia sativa* L.)

DESCRIPTION.

Habit: Annual or biennial straggling or climbing herb with weak slender angled stems, 1 to 3 feet long, usually branched, bearing pinnately compound leaves, the leaflets 6 to 14 in number, arranged oppositely along the midrib (rachis), the latter terminated by a branched or simple coiling tendril; each leaflet about 1 inch long, somewhat wedge-shaped, the squarrish free end broadly-notched with sometimes a blunt point in the notch, their margins entire and occasionally hairy; a pair of small toothed stipules at the base of the compound leaf. *Flowers* solitary or in pairs in the upper leaf-axils, pea-shaped with corolla about ¾ to 1 inch long, exceeding the calyx, the banner purple and wings reddish. *Ovary* becoming a slender smooth pod, 2 to 3 inches in length, containing 5 to 12 round seeds.

DISTRIBUTION.

Common Vetch is a native of Europe, where it has long been grown as a forage plant; in California chiefly as a vagrant in the Bay Region, growing in grainfields, rare in southern California; occasionally used as a cover crop in orchards.

Vicia faba L. (Broad Bean, Horse Bean, or Windsor Bean) is another species which occasionally persists for a year or two in the soil of old gardens about Los Angeles: well known by its larger dull white flowers, each with a large blue-black spot, and stout erect leafy stems, 1.5 to 3 feet tall.

FIREWEED OR GREAT WILLOW-HERB.

(*Epilobium angustifolium* L.)

DESCRIPTION.

Habit: Tall perennial herb with rather stout simple or branched stem, 2 to 6 feet high or rarely higher, glabrate below the finely hairy flower-group. *Leaves* alternate, very shortly stalked, entire or minutely toothed, 2 to 6 inches long and an inch or less wide, resembling willow leaves in shape and venation except that the tips of the side-veins run together in loops just within the leaf-margin, pale on the underside. *Flowers* large, ½ to 1 inch broad, grouped in long terminal racemes, each flower in the axil of a small slender bract and composed of a 4-parted calyx, 4 flaring lilac-purple petals, 8 purple stamens, and a single central pink style which rises above the *inferior* ovary. *Ovary* below the flower, appearing like a flower-stalk, ripening to a slender capsule, 2 to 3 inches long, 4-celled, containing very many minute brown seeds, each crowned with a tuft of fine white hairs by which the seeds are scattered in the wind.

DISTRIBUTION.

Distributed throughout the cooler parts of the northern hemisphere and found in California in the mountains of the North Coast and Sierra, especially abundant on burned-over lands.

SILVERY HAIR-GRASS.

(*Aira caryophyllea* L.)

DESCRIPTION.

Habit: Small delicate annual grass, smooth and glabrous throughout, with tufted erect culms, 6 to 12 inches high, bearing fine hair-like leaves, 2 inches or less in length, inrolled above, their sheaths roughened; flowers in spikelets which are usually densely aggregated at the ends of the spreading branches of the silvery-

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shining panicle, each spikelet 2-flowered with both the flowering glumes (lemmas) long-awned.

DISTRIBUTION.

This pretty little grass, a native of Europe, is now naturalized and common on old cattle ranges from northern California southward in the Coast Counties; unfortunately it seems to have no forage value, cattle rejecting it.

Fine Hair-grass (*A. capillaris* Host.), very closely resembling Silvery Hair-grass but with smaller spikelets placed singly at the ends of the panicle branches and only one of the florets long-awned, is present in the coast region of northern California.

VELVET-GRASS.

(*Notholcus lanatus* Nash)

DESCRIPTION.

Habit: Perennial grayish velvety grass with creeping fibrous rootstocks and ascending tufted slender stems, 1 to 2 feet high, very leafy. *Leaves* with soft flat blades, 6 inches or less in length, and inflated sheaths. *Flowers* in spikelets aggregated into a soft plume-like purplish terminal panicle, 2 to 5 inches long, each spikelet 2-flowered and much flattened sidewise, about ⅛ inch long, the upper floret bearing a short hooked awn at flowering time.

DISTRIBUTION.

Very handsome introduced grass, native of Europe, sometimes cultivated as a pasture grass but of small merit except on light poor soil where other grasses fail; abundantly naturalized on the hills and uplands of the North Coast Ranges.

BEAR-GRASS.

(*Stipa setigera* Presl.)

DESCRIPTION.

Habit: Large tufted perennial grass with erect culms, 1 to 3 feet high, bearing leaves, the basal with long and narrow, usually rolled, blades, the upper leaves flat, leaf-sheaths short and hairy at the throat; flowers in spikelets grouped in a loose nodding panicle 5 inches to 1 foot long, its branches in pairs, the spikelets drooping at the tips, their empty scales (glumes) long-pointed and purplish, the flowering scale (lemma) of the single flower with a twice bent awn, 2 to 4 inches long and hairy on its basal part.

DISTRIBUTION.

Abundant on dry hillsides, mesas, and open places through the Coast Ranges and eastward to Lassen and San Bernardino counties; widely distributed in western North America.

Other species of this genus, variously called Bear Grasses, Spear Grasses, Feather Grasses, and Porcupine Grasses, occur within the state, all more or less valuable forage grasses. To this genus also belongs the famous Sleepy Grass (*S. vaseyi* Scribn.)—so called for its narcotic effect upon horses—of the southwest (Colorado-New Mexico), a grass reported by Professor Hitchcock as having been collected once in California.

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MOUSE-EAR CHICKWEED.

(*Cerastium viscosum* L.)

DESCRIPTION.

Habit: Annual low herb, the tufted erect or spreading stems, 2 inches to 1 feet high and sticky-glandular. *Leaves* oval or broader above the middle, an inch or less long, the tips bluntly pointed or rounded, all opposite, their bases slightly joined about the enlarged stem joints. *Flowers* small, white, formed of 5 sepals as long or a little longer than the 5-notched or 2-cleft petals (these sometimes missing), 10 stamens, and central ovary with 5 styles. *Ovary* developing into a capsule, ½ inch long (twice as long as the calyx), rupturing at the top with 10 (or 8) teeth about the opening and containing many minute roughened orange or brownish seeds.

DISTRIBUTION.

Naturalized from Europe and now common in waste places or in gardens throughout the state.

Another very closely related species, a perennial herb of the Old World, very common in shady lawns, is *C. vulgatum* L. (Large Mouse-ear Chickweed), which may be distinguished from the above, when both are in fruit, by the flower-stalks of *C. vulgatum* being much longer than its calyx; in the annual species flower-stalk and calyx are about equal.

Field or Meadow Mouse-ear Chickweed (*C. arvense* L.) is a native perennial plant growing in the Coast Ranges and Sierra Nevada in rocky places and spreading by rootstocks, rarely a nuisance; it may be recognized from either of the preceding by its white petals broadly rounded and deeply notched, twice as long as the sepals.

EVENING PRIMROSE.

(*Oenothera hookeri* T. & G.)

DESCRIPTION.

Habit: Biennial herb with usually simple erect hairy stem 2 to 6 feet high, oval or lance-shaped leaves about 6 inches long, and large flowers, pale yellow at first but fading reddish, formed of an elongated calyx, which appears like a flower-stalk (inferior ovary), the 4 sepals only free at their tips, 4 large heart-shaped petals, 1 to 2 inches broad and about as long, 8 stamens with anthers ½ inch in length and teetering upon the ends of their stalks; solitary style longer than the stamens with 4 spreading stigma lobes at its apex. *Fruit* a capsule, 4-sided, 1 to 2 inches long, very hairy, containing many minute sharply-angled brown seeds.

DISTRIBUTION.

This splendid plant is more than a weed, though in some places exhibiting weed-like exuberance of growth; it is found from northern California to the Mexican boundary, growing especially along streams in the Coast Ranges and lower Sierra and mountains of southern California; very beautiful in Yosemite Valley.

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GOLDEN EGGS.

(*Oenothera ovata* Nutt.)

DESCRIPTION.

Habit: Allied botanically to the last described plant but very different in appearance, being practically stemless, the 3 to 6 inch oblong blunt leaves crowded together upon a very short stem not rising above the ground, the leaves spreading in a rosette. *Flowers* bright clear yellow, the calyx appearing like a slender flower-stalk about 3 inches long and enclosing a small ovary at the base, corolla of 4 rounded petals, ½ inch in diameter, 8 stamens, and central style which runs down the calyx-tube to the nearly buried ovary, the latter becoming a papery capsule about an inch long containing the seeds.

DISTRIBUTION.

Abundant in the coast mountains of central California (Mendocino to San Luis Obispo) upon the open grassy hills and in the valleys, occasionally so numerous as seriously to diminish the forage value of the range.

MEXICAN PRICKLY POPPY.

(*Argemone mexicana* L.)

DESCRIPTION.

Habit: Annual prickly glabrous herb with yellow acrid juice, the stout prickly stem 1 to 2 feet high, simple or with a few branches, large unstalked clasping leaves 3 to 10 inches long and about half as wide, white-spotted, their margins coarsely and irregularly deeply toothed and excessively prickly, yellow or cream-colored flowers 1 to 2 inches across, composed of 2 or 3 sepals, 4 to 6 petals and many stamens, the central ovary crowned by a flat branching stigma and becoming a prickly capsule an inch or more long, containing the many pitted grayish-brown seeds.

DISTRIBUTION.

Native from Texas to Central America, now widely distributed in all warm countries as a pernicious weed, reported as occurring in the Imperial Valley.

A native species with pure white flowers (*A. platyceras* var. *hispida* Prain), known as "Chicalote," ranges from Lake County to San Diego.

SUMMER LUPINE.

(*Lupinus formosus* Greene)

DESCRIPTION.

Habit: Silky-hairy perennial herb with ascending or straggling stems 2 to 3 feet long, compound leaves. *Leaflets* 1 to 1.5 inches in length, spreading like the fingers of a hand (palmate leaf) from the top of the inch-long leaf-stalk, each leaflet broadening upward from the base to well above the middle and then sharply pointed, deep violet flowers, pea-shaped, about ½ inch long, arranged in terminal racemes 6 to 8 inches in length, the flowers often occurring in indistinct whorls; pods flattened, narrow, containing about 10 seeds. Flowering from June to October.

DISTRIBUTION.

Fields and meadows of the Great Valley and in the Coast Range from central to southern California, the commonest summer lupine.

California has many native lupines, some found only in the mountains, or along the sea-shore, others more widely distributed and a few growing so abundantly over our mesas and plains as to dominate the

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landscape during flowering time: the following key will permit recognition of the half-dozen species most commonly found in the lowlands:

Key to the Common Lupines.

Plant with hollow stem and stinging nettle-like hairs.....*L. hirsutissimus*
Stem solid, no stinging hairs.
Bracts of the inflorescence remaining upon the stalk throughout the season of flowering and fruiting.
Flowers white or yellow.....*L. densiflorus*
Flowers purple or pinkish.....*L. microcarpus*
Bracts falling soon after the flowers open.
Flowers grouped in distinct whorls along the stem of the inflorescence.
Corolla deep bluish-purple: plants stout and succulent, nearly glabrous .....*L. affinus*
Corolla blue: plants slender, not succulent, hairy.
Corolla ½ inch long.....*L. nanus*
Corolla ¼ inch long.....*L. micranthus*
Flowers not in whorls, scattered along the stem.....*L. truncatus*

Many native lupines of the western United States have been demonstrated to be poisonous to stock and it is by no means probable that all of the toxic kinds have as yet been recognized. Stock do not as a rule graze lupines unless the forage is very poor, when serious results may follow if these plants are abundant, especially if the seeds are well matured.

CURSED CROWFOOT.

(*Ranunculus scleratus* L.)

DESCRIPTION.

Habit: Stout annual herb ½ to 2 feet high, the freely branching hollow stem sometimes an inch through; radical leaves thickish, the heart-shaped blade 1 to 2 inches across and deeply palmately lobed into 3 to 5 lobes, leaf-stalk 2 to 3 inches long and broad, upper leaves sessile, smaller, deeply lobed, the divisions usually 3, entire or toothed at their summits. *Flowers* yellow, numerous, small, less than ½ inch across, their centers occupied by a conical receptacle about ¼ to ½ inch high, upon which the pistils are arranged spirally, the many petals and stamens spreading at the base of this receptacle. *Fruits* dry, 1-seeded, each about the size of a mustard seed, with a small beak at the free end (achene).

DISTRIBUTION.

Cursed Crowfoot or Blisterwort, a native of Europe, has been reported from California, though I have seen no authentic specimens from within the state; its ill repute, suggested by the common name, is due to the bitter acrid and blistering juice, which can produce serious sores in the mouths of cattle. This poisonous quality is shared by practically all species of the genus, which includes about a dozen of our native plants, among them the well-known California Buttercup (*R. californicus* Bentham), a perennial herb with showy bright yellow flowers, ⅓ to ⅔ inch across, and deep green herbage, exceedingly common in late winter and early spring all over the valleys and low grassy hills.

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CANCHALAGUA.

(*Erythraea venusta* Gray)

DESCRIPTION.

Habit: Slender glabrous annual with bitter juice, the erect leafy stem 1 foot or less in height, simple or branched at the top, with pointed sessile ovate leaves scarcely an inch long, and flowers in a showy cluster. *Flower*, 4 or 5-parted, both calyx and corolla with distinct tubes below their free tips, the corolla bright pink with a yellow center, flaring broadly at the summit, ¾ to 1 foot across. *Ovary* one-celled, becoming a capsule containing numerous round seeds with pitted seed-coats. Flowering in late spring and early summer.

DISTRIBUTION.

This is but one of several "canchalaguas" growing within the state, though it is the handsomest; common in all southern California in the interior valleys and ranging north along the Sierra Nevada to central California. The other species are similar but smaller flowered.

COMMON INDIAN HEMP.

(*Apocynum cannabinum* L.)

DESCRIPTION.

Habit: Perennial herb with acrid milky juice, the stem 2 to 4 feet tall, erect and much branched, the branches ascending, opposite narrow lance-shaped leaves, 1.5 to 3 inches long, very shortly stalked or sessile, and small greenish-white flowers grouped in dense terminal clusters (cymes). *Herbage* light green and glabrous or the leaves finely hairy beneath; flower bell-shaped, ⅛ inch long, the free tips of the petals ascending above the stupe which has 5 stamens attached to it near the base by very short stalks, the corolla-tube surrounding the pair of small ovaries which develop into pods (follicles) about 4 inches long, containing a great many thin flat brown seeds, each tipped with a crown of fine white silky hairs.

DISTRIBUTION.

This is fairly common throughout the state, growing along streams or in moist places, especially abundant at certain points along the San Joaquin and Sacramento rivers, and feared by stockmen as a plant poisonous to cattle.

MOTH MULLEIN.

(*Verbascum virgatum* Stokes)

DESCRIPTION.

Habit: Annual (or rarely biennial) herb with erect stout simple stem, 2 to 4 feet high, somewhat hairy-glandular. *Leaves* alternate, the lower stalked, 3 to 6 inches long, ovate or broader above the middle, their margins roundly lobed (crenate), lower leaves smaller with heart-shaped clasping bases which run down the stem slightly. *Flowers* yellow or whitish, ¾ inch broad, solitary or in small clusters in the axils of the upper leaves, each on a very short flower-stalk and formed of a 5-parted calyx, a nearly regular 5-parted corolla, 5 stamens with stalks densely covered with violet woolly hairs, and central ovary developing to a 2-celled capsule containing numerous wrinkled brown seeds.

DISTRIBUTION.

Introduced from the Old World many years ago and now frequent in waste places about towns and cities throughout the lower parts of the state.

Common Mullein (*V. thapsus* L.), a densely soft woolly herb, also of European origin, with yellow unstalked flowers in a long densely

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flowered cylindrical spike and with at least some of the stamen stalks (filaments) without hairs, is fairly common in northern California about old farmsteads or along streambeds and quite aboundant in many of the foothill valleys of the west slope of the Sierra.

OWL'S CLOVER.

(*Orthocarpus purpurascens* Bentham)

DESCRIPTION.

Habit: Annual herb 4 to 16 inches high with erect stem, simple at first but becoming several-branched from near the base, the branches erect, soft-hairy. *Leaves* alternate, green or slightly brownish, divided into many thread-like segments. *Flowers* in dense terminal thick spikes, each flower in the axil of a bract as long as its flower and deeply cleft, the divisions crimson-purple; flower composed of a calyx of 5 united sepals but split into several narrow lobes, the lobes colored like the bract, corolla about an inch long, 2-lipped, the purple upper lip arched over the yellow short and inflated lower, stamens 4 with hairy filaments. *Ovary* solitary, 2-celled, becoming a capsule containing numerous brown seeds.

DISTRIBUTION.

Common throughout central and southern California, both along the coast and in the Great Valley, particularly on light sandy soils.

Closely related abundant species are (1) *O. erianthus* Benth. (Johnny-tuck), with slender yellow spikes and green bracts, very widely spread in the Great Valley and central Coast Ranges; (2) *O. lithospermoides* Benth. (Cream Sacs), with thick dense spikes of cream-colored flowers at the top of generally simple stems, a species of central California; and (3) *O. densiflorus* Benth. (Escobita), very much resembling Owl's Clover but technically distinct by its stamens without hairs upon their stalks and by the arched lip (galea) of the corolla lacking purple hairs on its back: in Owl's Clover the galea is densely clothed outside by deep purple hairs.

GROUND CHERRY.

(*Physalis wrightii* Gray)

DESCRIPTION.

Habit: Annual herb 6 inches to 1 foot high, the angles smooth, stem branching and spreading from the base. *Leaves* alternate, simple, oblong or bluntly pointed, wavy-toothed on the margins, about an inch long or rarely longer, on short stalks. *Flowers* on slender flower-stalks in the leaf-axils, each flower with a 5-parted flaring bell-shaped white or faintly yellow corolla about ½ inch across, twice as long as the calyx. *Ovary* becoming a 2-celled juicy berry enclosed within the persisting 5-angled bladdery and veiny calyx and containing many small kidney-shaped pitted seeds.

DISTRIBUTION.

This ground cherry is now a fairly common intruder into fields and truck gardens in Imperial Valley; native of Texas.

Another ground cherry, *P. ixocarpa* Brot., having bright yellow corollas with purple throats, is a frequent escape about Los Angeles; native of Mexico and esteemed by the Mexicans for the fruit.

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FIELD MADDER.

(*Sherardia arvensis* L.)

DESCRIPTION.

Habit: Tufted annual with numerous slender square stems 3 inches to 1 foot long, prostrate and matted or ascending. *Leaves* small, sharp-pointed, ⅜ inch long or less, arranged in whorls of 4's to 6's upon the stems. *Herbage* usually more or less rough hairy; flowers small, clustered in 2's or 3's at the ends of the stems, each cluster surrounded by a close whorl (involucre) of small partially united leaves, corolla blue or sometimes pink, its pointed lobes spreading above the slender funnel-form tube, the inferior ovary 2-celled, separating at maturity into a pair of 1-seeded dry half-fruits, for a time retained within the persisting calyx.

DISTRIBUTION.

Forming mats upon the ground at various places in central California, especially on pastures in the Coast Counties; native of Europe.

COMMON DANDELION.

(*Taraxacum officinale* Weber)

DESCRIPTION.

Habit: Perennial stemless herb with basal bunched deeply and irregularly lobed green and somewhat succulent leaves, 2 to 10 inches long, and rather large heads of bright yellow flowers borne at the summit of hollow stalks, each head with an involucre of unequal green bracts, the outer much smaller than the pointed inner series, the many flowers with corollas all alike, 5-toothed at the squarrish tip; fruits dry 1-seeded (achenes), 4 to 5-angled and nerved, somewhat roughened and tapering above into a slender beak, tipped with a crown of numerous unequal white simple and persistent bristles.

DISTRIBUTION.

The Common Dandelion, familiar to everyone, is a late immigrant to the Pacific coast, but is fast becoming established as a pest in lawns throughout central and southern California.

COMMON GOLDENROD.

(*Solidago californica* Nutt.)

DESCRIPTION.

Habit: Perennial herb with rigid erect stem, 2 to 4 feet high, branched at the top where the yellow flowers are grouped in densely clustered small heads, these aggregated into a narrow strict and compact panicle, ⅓ to 1.5 feet long, its erect branches with their heads of flowers more or less one-sided (secund). *Leaves* oblong, pointed at the free end and tapering below to a narrow base or short stalk, the lower leaves sometimes 4 inches long, the upper shorter; heads ⅛ inch high, bracts of the involucre narrow, somewhat thick and papery, ray-florets 7 to 12, disk-florets more numerous; achenes hairy.

DISTRIBUTION.

Though none of the several goldenrods present in the state bulk so large in the vegetation as the eastern types, three or four species are fairly common, the one described being possibly the one most often noted since it grows in dry open places on the hillsides or on the plains almost throughout the lower parts of the state except the southeastern deserts. A related plant is the Western Goldenrod (*S. occidentalis* Nutt.), found in marshy tracts or along streams from Oregon to southern California: its panicle is much more open, the branches rising nearly to the same level and forming a broadly convex (corymbose) cluster.

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SMOOTH HAWKSBEARD.

(*Crepis capillaris* Wallr.)

DESCRIPTION.

Habit: Annual (possible occasionally living two seasons) herb with erect, usually slender stem, 1 to 2 feet high, branched near the top, bearing large rather thin lower or basal leaves, 3 to 6 inches long and one-third as wide, their margins deeply lobed or irregularly toothed, distinctly stalked, upper leaves sessile by clasping bases, the uppermost reduced and more or less bract-like, herbage essentially glabrous; yellow flowers in numerous small heads, ¼ inch high, the smooth achenes narrow-oblong, slightly tapering to both ends, surmounted by a pappus of numerous soft white simple hairs.

DISTRIBUTION.

This Old World immigrant weed is now found both in the Bay Region of central California and in the southern part of the state and may be expected to widen its area of occupation. Another species, *C. biennis* L.—the Rough Hawksbeard—is reported as occurring in southern California, though I have seen no authentic specimens; herbage hairy, the hairs more or less stiff and harsh.

YELLOW SORREL OR LADY'S SORREL.

(*Oxalis corniculata* L.)

DESCRIPTION.

Habit: Small low herb with sour juice, spreading by means of numerous pale runners, rooting at the nodes, the erect or ascending branches 2 to 6 inches high. *Leaves* compound, composed of 3 heart-shaped leaflets united to their common leaf-stalk by their pointed ends (much like a clover leaf), the leaflets green or not rarely purple tinged, about ½ inch wide, herbage hairy. *Flowers* small, grouped in umbels of 2 to 6 flowers or sometimes the flower solitary, corollas yellow, twice as long as the calyx. *Ovary* becoming an oblong capsule, ⅓ to ⅔ inch long, hairy and pointed at its apex, containing a number of brown and wrinkled seeds.

DISTRIBUTION.

Weed of shady lawns and greenhouses, flowering most of the year; adventive from Europe and now established throughout the settled parts of the state.

BLUE TOAD-FLAX.

(*Linaria canadensis* Dumont)

DESCRIPTION.

Habit: Annual or biennial glabrous green herb, sometimes fleshy, the erect or ascending simple or branched flowering stems rising 1 to 2 feet high, usually with a circle of shorter spreading sterile shoots at base, very leafy. *Leaves* entire, sessile, ½ to 2 inches long, strap-shaped, those of the flowering stems mostly alternate, the sterile shoots bearing broader leaves which are often opposite or whorled. *Flowers* about ½ inch long, grouped in long slender terminal racemes, each flower on a slender erect stalk and composed of a 5-parted calyx, 2-lipped corolla, blue except for the white lower lip which closes the opening to the corolla tube, 4 stamens in unequal pairs, and central globose ovary, the latter becoming a rounded capsule which opens by pores or slits below its summit to free the numerous small angled dark-brown seeds.

DISTRIBUTION.

Native herb widely distributed in the cooler parts of North America, in California mainly found in sandy fields from the Oregon line to southern California.

Butter-and-eggs or Yellow Toad-flax (*L. vulgaris* Hill), a handsome yellow-flowered species twice as large as the above described plant, a pernicious perennial weed of the eastern United States, very difficult to eradicate because of its vigorous running rootstocks, is present in California in a few places about San Francisco Bay.

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PURPLE FOXGLOVE.

(*Digitalis purpurea* L.)

DESCRIPTION.

Habit: Tall hairy biennial herb, the erect usually stout simple stem 2 to 6 feet high, bearing alternate broadly lance-shaped leaves with toothed margins, the lower ½ to nearly a foot in length, stalked, the upper leaves smaller, sessile; the showy flowers closely grouped in long terminal usually 1-sided racemes, each flower with a trumpet-shaped purple to white drooping corolla, ½ inch long, red-spotted on the inside, the ovary becoming an oval capsule containing many rough brown seeds.

DISTRIBUTION.

Poisonous but medicinally valuable Old World plant now naturalized at various places in moist bottom lands on the north coast of California.

MORNING BRIDE OR SWEET SCABIOUS.

(*Scabiosa atropurpurea* L.)

DESCRIPTION.

Habit: Perennial garden herb with branching stems, 2 to 3 feet high. *Leaves* various, the lower deeply cut with a very large terminal lobe above the smaller lateral paired lobes (lyrate leaf), middle leaves compound with segments subequal, upper stem leaves simple with coarsely toothed or even nearly entire margins. *Flowers* very dark purple to nearly white, closely aggregated into convex broad heads, 1 to 2 inches across, at the ends of the naked stem branches, each head enclosed at base by an involucre of many bracts; corolla 5-lobed, the marginal flowers of the head with larger corollas, their lower lobes much the largest. *Ovary* becoming an achene tipped by 5 slender long awns.

DISTRIBUTION.

Native of Europe, now found at several places in central California along roadsides or in waste fields, apparently enlarging its area of occupation.

SLENDER ASTER.

(*Aster exilis* Ell.)

DESCRIPTION.

Habit: Slender erect annual herb, 1 to 3.5 feet high, the stoutish stem simple below but branching above, the branches many and slender. *Leaves* narrow, 3 to 4 inches long, mostly with even margins though occasionally toothed, the upper leaves smaller than the lower. *Flowers* grouped in small numerous heads, each head about ¼ inch high, surrounded at base by an involucre of narrow long-pointed green bracts, composed of both ray and disk florets, the former about 15 to the head, light pink or purple, disk-florets yellow; achenes with a pappus formed of long white, fine and soft hairs.

DISTRIBUTION.

Common weed of southern California along river bottoms and in low and wet waste lands from Los Angeles to Imperial Valley, especially in alkali soils.

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SALSIFY OR OYSTER-PLANT.

(*Tragopogon porrifolius* L.)

DESCRIPTION.

Habit: Biennial (or occasionally perennial) glabrous somewhat succulent herb, with stout erect generally unbranched stem 2 to 4 feet high, bearing below numerous alternate grass-like deep green leaves, each 8 inches to 1 foot, smooth and soft, with clasping bases, upper leaves much shorter or almost bract-like, and a single large terminal head of purple flowers, the stem being swollen and hollow just below it; head 2 to 4 inches broad, enclosed at base by an involucre of green long-pointed bracts arranged in a single series and generally much overtopping the center of the head; corollas all alike, each with a broad ray square at its free end and 5-toothed; ovaries becoming many oblong achenes, about ½ inch long, tipped with a thread-like beak which bears at its upper end a crown of about 5 ash-colored slender branching bristles, the whole achene, including the bristles (pappus), 1.5 to 2 inches long.

DISTRIBUTION.

Waste places about towns and cities, especially along the coast, an escape from old-time gardens.

WART-CRESS.

(*Coronopus didymus* Smith)

DESCRIPTION.

Habit: Prostrate fetid annual with numerous freely branching slightly hairy stems, 6 inches to 2 feet long, bearing dissected leaves and minute greenish-white flowers. *Leaves* 1 inch or less in length, the lower slender-stalked, the upper unstalked, all deeply lobed and the lobes again incised, the tips of the segments sharply pointed. *Flower* composed of 4 minute sepals and as many slightly larger petals, often only 2 stamens though not rarely 4 (and sometimes all 6 of the regular cruciferous flower and then unequal, 4 long, 2 short), and central ovary which ripens to a round rough-wrinkled 2-celled pod, about 1/12 inch in diameter and notched at the apex, the pod breaking into a pair of 1-seeded nutlets.

DISTRIBUTION.

Old World weed now cosmopolitan and found in the coast region of Central California and inland as far as the Sierra foothills.

A nearly related form, as yet very uncommon in California though reported as occurring in San Francisco, is *C. procumbens* Gilibert (Swine-cress), differing by its round warty pod not notched at the apex; the odor of the plant more or less similar to that of a pigsty (whence the common name).

CUT-LEAVE GOOSEFOOT.

(*Roubieva multifida* Moq.)

DESCRIPTION.

Habit: Perennial, glandular-hairy and strong scented, prostrate and much-branched herb, with some ascending branches rising a foot or so above the ground, very leafy with narrow small short-stalked leaves, ½ to 1.5 inches long and one-third as wide at the most, and minute perfect or pistillate green flowers without petals, solitary or in small (2 to 5) rounded clusters in the leaf-axils, their ovaries becoming bladdery 1-seeded small dry fruits (utricles) retained within the persistent 3-nerved and prominently veined calyx.

DISTRIBUTION.

Native of South America, introduced into California at several places along the coast and growing in waste places.

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STINK-WEED OR JACKASS CLOVER.

(*Wislizenia refracta* Engelm.)

DESCRIPTION.

Habit: Native smooth strong scented annual herb, 1 to 2 feet high or occasionally twice this height, the erect branching stem bearing alternate compound tri-foliate leaves and small yellow flowers. *Leaflets* ½ to ¾ inches long, oblong or wider above the middle, spreading from the top of the leaf-stalk which is scarcely as long as the leaflets. *Flowers* grouped in a dense raceme which lengthens as the fruit matures, each flower 4-parted, the petals about 1/12 inch long, shorter than the 6 stamens and single central pistil. *Ovary* raised upon the end of a stalk, becoming a 2-celled pod, splitting into a pair of nutlets.

DISTRIBUTION.

Native of southeastern California eastward to New Mexico and growing in the Great Valley as far north as Sacramento County, perhaps here as an immigrant, of considerable value as a bee-plant.

BEGGAR-TICKS OR STICK TIGHT.

(*Bidens frondosa* L.)

DESCRIPTION.

Habit: Annual smooth or slightly hairy herb with erect, 2 to 5 feet tall, branching stem with compound leaves and greenish-yellow flowers aggregated into heads terminating slender naked stem branches; leaves 3 or 5-divided, the veiny leaflets separately stalked, somewhat triangular in outline with margins coarsely and sharply toothed, or the upper leaves smaller and merely 3-parted or sometimes undivided; heads many, about ¼ inch high, surrounded at base by an involucre composed of large green bracts, the outer much overtopping the center of the head, ray-florets small, few or none, disk-florets numerous, their ovaries becoming flattened dry 1-seeded rough-hairy black fruits (achenes), about ⅛ inch long and tipped with 2 sharp-pointed erect barbed awns longer than the corolla.

DISTRIBUTION.

This is one of the most widely distributed and annoying weeds in the United States, the achenes being so easily carried from place to place fastened in the hair of animals, especially sheep. It is very common along the lower Sacramento and San Joaquin rivers.

A very closely allied plant is *B. pilosa* L., with generally similar characters but the achenes longer, more slender and 4-angled, a tropical weed introduced long ago into southern California and now common there along streams and irrigating ditches.

Other weedy *Bidens* species are found within the state but we can merely mention *B. expansa* Greene, a common and handsome water plant with simple leaves and conspicuous golden ray-florets, found growing in shallow streams about Los Angeles and inland as far as San Bernardino, also lately introduced into Imperial Valley; and *B. laevis* B. S. P., the Swamp Bur Marigold of central California.

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BUTTON SNAKEROOT OR COYOTE-THISTLE.

(*Eryngium armatum* C. & R.)

DESCRIPTION.

Habit: Perennial diffusely branching herb with sprawling stems, 3 inches to 1 foot long, bearing opposite oblong stiff leaves, 2 to 3 inches long, broader above the middle, lobed or merely toothed, the divisions spiny-tipped, and greenish-white flowers grouped in green, stalked heads, each head surrounded at base by a whorl of unequal spinescent bracts, the 2-celled inferior ovary of the individual flower, when mature, splitting into a pair of 1-seeded dry half-fruits, scaly with thin whitish scales on their outer sides.

DISTRIBUTION.

This is but one of several so-called "coyote-thistles" found in California, all of them closely agreeing with the above in general character; the plant described grows along the coast from Sonoma County south to Monterey, frequently being a nuisance in lowlying pastures. Another species, the Blue Thistle (*E. articulatum* Hooker) of the Sacramento Valley, is valued as a bee-plant: head bluish in color. Still another (*E. parishii* C. & R.) is found in swampy places near the coast in Orange and San Diego counties.

SHEPHERD'S NEEDLE OR DEVIL'S DARNING-NEEDLE.

(*Scandix pecten-veneris* L.)

DESCRIPTION.

Habit: European annual weed, now fairly common about San Francisco Bay, with erect simple or branched hairy stem ½ to 1.5 feet high, pinnately dissected leaves, their segments very narrow and pointed, and small white flowers grouped in compound umbels, the stalks of the small umbels about ½ to 1 inch long; the single inferior ovary maturing as a ribbed fruit, about ½ inch long, tipped by a straight flat beak ("needle"), 1.5 to 2 inches long, its edges rough with stiff bristles.

DISTRIBUTION.

Weed of fields and pastures dangerous to stock, the needles causing sores in mouths and muzzles.

PARSNIP.

(*Pastinaca sativa* L.)

DESCRIPTION.

Habit: Tall (2 to 4 feet) erect generally biennial herb with angled branching stem, pinnate leaves, and good-size compound umbels of yellow flowers; lower leaves often 1 to 1.5 feet long, stalked, their thin leaflets oval with blunt ends, more or less lobed and margins sharply toothed, 1 to 3 inches long, upper leaves reduced; flowers 5-parted except the single inferior ovary, small, the yellow petals curling inward toward the center of the flower; ovary ripening to a flattened oval ribbed fruit with conspicuous dark lines upon each caused by the oil-tubes.

DISTRIBUTION.

This is the cultivated parsnip so frequently escaped about truck-gardens or farther afield in lowlying marshy tracts, or sometimes in drier ground along roadsides.

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CRESSA OR ALKALI CLOVER.

(*Cressa cretica* L. var. *truxillensis* Choisy)

DESCRIPTION.

Habit: Low silky-hairy and hoary perennial herb, commonly densely branched from the base, the erect or sprawling tufted stems 3 to 8 inches long, very leafy with many small (⅛ to ½ inch long) oblong or oval, very shortly stalked leaves, and small white flowers, each about ⅛ inch in length, borne on minute flower-stalks in the axils of the upper leaves. *Flowers* composed of 5 free sepals and as many petals, the latter joined to form a bell-shaped silky-hairy corolla to the inner side of which the 5 stamens are attached around the solitary ovary with its 2 styles, the ovary becoming a hairy capsule usually with one seed. Flowering in summer.

DISTRIBUTION.

Saline soils of the Great Valley and southern California eastward to Arizona, very abundant on alkali lands in the San Joaquin Valley.

WILD CARROT OR BIRD'S-NEST PLANT.

(*Daucus carota* L.)

DESCRIPTION.

Habit: Stiffly-hairy biennial herb with large conical fleshy root and erect branching stems, 2 to 3 feet high, bearing large basal many-times divided leaves, the upper leaves smaller and less divided, all leaf-segments narrow with incised or deeply lobed margins, and large compound umbels (2 to 4 inches across) of small flowers with white or rarely pinkish corollas (the central flower of the umbel often purple); rays of the primary umbel numerous, crowded, ½ to 2 inches long, the outer rays the longer. *Ovary* of the flower inferior, becoming a dry bristly ribbed fruit, ¼ inch long or less, the fruiting umbel concave above, its shape suggesting one of the common names applied to this Old World plant from which the garden carrot has been derived.

DISTRIBUTION.

Naturalized in waste places in valley lands throughout the settled parts of the state.

There is a native species, *D. pusillus* Michx., less than a foot high, widely distributed on the drier uplands of California, which has been considered by the Spanish-Californians as an antidote for rattlesnake venom—hence their name for this plant, "Yerba del Vibora."

MAT-GRASS.

(*Lippia nodiflora* Michx.)

DESCRIPTION.

Habit: Prostrate perennial herb, the creeping stems, 1 to 3 feet long, spreading widely from the half-woody crown and rooting at the joints, bearing simple opposite thickish unstalked leaves, 1 inch or less in length, long-wedged-shaped at base with their rounded summits coarsely-toothed. *Herbage* finely hairy. *Flowers* very small, verbena-like in shape, about 1/12 inch broad at the top of the flaring white or purple corolla, grouped in dense oblong heads at the ends of short (1 to 4 inches) erect generally leafless branches of the creeping stems.

DISTRIBUTION.

In California fairly abundant in the Sacramento-San Joaquin delta region, especially on stream banks; of some value as a soil-binder on irrigation levees.

A closely related plant is *L. lanceolata* Michx., found in the same district and also in southern California in marshy places along slow-running streams—commonly known as Fog-fruit, with thinner, lance-shaped leaves and pale blue flowers.

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GOLDEN-TOP.

(*Lamarckia aurea* Moench.)

DESCRIPTION.

Habit: Mediterranean immigrant annual grass, abundantly naturalized in southern California and advancing northward along the coast, with erect tufted culms 4 to 12 inches tall, bearing thin smooth flat leaves, 2 to 4 inches long, and flowers in spikelets grouped in handsome shining golden or purple-tinged 1-sided panicles, 1 to 3 inches long; spikelets arranged in groups (fascicles), each containing a single perfect fertile spikelet enclosing a single perfect flower, this fertile spikelet surrounded by several (1 to 3) sterile much longer spikelets, each fascicle with a tuft of long white hairs at its base; flowering scale (lemma) of the perfect flower with an awn about ½ inch long.

DISTRIBUTION.

Common on grassy hills and in the valleys, also along roadsides or paths in the smaller towns.

WHITE-STEMMED GUM-PLANT.

(*Grindelia camporum* Greene)

DESCRIPTION.

Habit: Herbaceous perennial, the several smooth white shining stems tufted above the stout root and rising 1 to 2 feet in height, bearing numerous light green viscid leaves, 2 inches or less long, with toothed margins, the lower oblong and blunt-pointed, upper leaves with clasping bases and wider above the middle, and large rather numerous heads grouped in an open spreading panicle, the unopened heads whitened with a sticky excretion; heads with urn-shaped involucres, composed of green broad-pointed bracts, surrounding the many bright yellow ray and disk florets, their ovaries becoming short thick achenes, each with a pappus of 2 to 8 stout awns or bristles on its flat crown, these awns soon falling.

DISTRIBUTION.

White-stemmed Gum-plant grows in southern California and along the inner Coast Ranges as far as San Benito County, also abundant on the open plains of the Great Valley as far north as Sacramento. There are several other native species within the state, all similar to the one described and all possessing in varying amount the peculiar gumminess for which the plants are considered to have some medicinal value.

CALIFORNIA PRICKLY PEAR.

(*Opuntia occidentalis* Engelm.)

DESCRIPTION.

Habit: Succulent spiny plant, erect and spreading, 2 to 8 feet high, with flattened stem-joints, 6 inches to 1 foot long and about two-thirds as broad, bearing small green round leaves that soon fall away in early spring, their place of attachment upon the stem-joints indicated by an *areole* covered with brownish wool interspersed with bristles and spines, and solitary large and showy flowers, yellow with orange centers, 2.5 to 3 inches across, composed of numerous pointed sepals and petals arranged in several series, very numerous stamens, and central 1-celled inferior ovary, the latter becoming an egg-shaped sour juicy and purple berry ("pear"), 2 inches long, containing many white flat seeds, each about ⅛ inch broad.

DISTRIBUTION.

California Prickly Pear grows in southern California upon the dry hills or floors of the interior valleys, usually forming dense thickets several yards across. A nearly related sea-shore species is *O. littoralis* B. & R., perhaps best regarded as only a variety of the inland form.

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BLOW-WIVES.

(*Achyrachaena mollis* Schauer)

DESCRIPTION.

Habit: Soft-hairy sparingly branched annual herb, ⅔ to 1.5 feet high, the half-naked branches erect and capped by solitary rather large heads (¾ inch high) of small ray and larger disk-florets, golden-yellow at first but becoming reddish-brown in age. *Leaves* narrow, 2 to 5 inches long, with entire or fine toothed margins, the lower opposite, the upper alternate; heads surrounded at base by an involucre of green lance-shaped bracts which at length fall away from the fruiting rounded heads, 1.25 to 1.75 inches across, the latter very conspicuous with the silvery shining pappus scales which stand out stiffly from each other at the end of the black ribbed achene; scales about 10 in number.

DISTRIBUTION.

Very abundant in many places of central California, especially upon heavy (adobe) soils; less common in southern California.

HAIRY AGOSERIS OR FALSE DANDELION.

(*Agoseris hirsuta* Greene)

DESCRIPTION.

Habit: Perennial herb about a foot tall with a stout woody taproot, erect stem, tufted basal leaves, and good-size head of yellow flowers; leafy part of the stem very short, its naked and much longer upper part stalk-like, reddish, and supporting the head of flowers; leaves 2 to 4 inches long, usually compound with narrow segments but frequently merely toothed and broader above the middle; heads enclosed at base by a green involucre of several series of bracts and containing numerous flowers all alike, yellow at first but turning reddish, their ovaries developing into dry 1-seeded fruits (achenes) about ⅛ inch long, with summits tapering to slender thread-like beaks, twice as long as the body of the achene and tipped by a crown of numerous soft fine pappus hairs, dull white or faintly yellow in color.

DISTRIBUTION.

This False Dandelion is fairly common about San Francisco Bay in grassy places, flowering and fruiting in summer. Our flora includes a number of other species, all of similar appearance though differing in leaf or fruit characters.

SAGEBRUSH.

(*Artemisia tridentata* Nutt.)

DESCRIPTION.

Habit: Shrub varying in height from 1 to 10 feet, silvery-hairy, the much branched erect stems rising above a distinct trunk with shreddy bark. *Leaves* alternate, ⅔ to 1.5 inches long, unstalked and wedge-shaped at base, mostly with the summits deeply lobed into usually 3 bluntly pointed teeth, or the upper leaves narrow (linear) and entire. *Herbage* aromatic and bitter. *Flowers* in small greenish-yellow heads with involucres of dry bracts arranged in several overlapping series, the heads very numerous, grouped in panicles on the upper ends of the stems, each head containing 5 to 8 flowers without rays, the ovaries becoming achenes destitute of pappus.

DISTRIBUTION.

Perhaps the most abundant shrub of the southwest, covering enormous areas in the Great Basin, Arizona, and the dry interior of California east and south of the Great Valley, approaching the coast in southern California (Los Angeles County near Glendale).

This genus includes a great many species in western North America, a number present in California besides the Common Sagebrush just

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described and California Mugwort; among these other species may be mentioned Old Man or Hill-brush (*A. californica* Less.), the first name suggested by its usually hoary leaves which are either entire and thread-like in shape or compound and cut into thread-like segments, a native shrub growing on the drier hills of the Coast Ranges south of San Francisco; and *A. biennis* Willd. (Wormwood), an annual or biennial herb of the northwest, introduced about San Francisco Bay and in the low ground between Los Angeles and San Pedro, with variously shaped glabrous and nearly tasteless aromatic leaves, deep green and thickly crowded upon the 10 to 40 inch tall stems, the heads in dense small rounded clusters.

YARROW OR MILFOIL.

(*Achillea millefolium* L.)

DESCRIPTION.

Habit: Perennial hairy herb, 2 to 3 feet high, growing erect from trailing rootstocks, with finely dissected leaves and numerous small heads of white and yellow flowers grouped in flattened clusters at the ends of the stem branches; basal leaves stalked, stem leaves sessile, all narrowly lance-shaped in outline but cut into narrow deeply lobed segments which are thickly crowded upon the midrib (rachis); heads composed of both white or pinkish ray and yellow disk-florets and surrounded below by an involucre composed of few bracts with papery margins; achenes angled and without hairs (pappus) on their summits.

DISTRIBUTION.

Old World weed widely distributed in North America and in California showing some marked varieties which may be indigenous, especially in the mountains.

FOUR-LEAVED ALL-SEED.

(*Polycarpon tetraphyllum* L.)

DESCRIPTION.

Habit: Low much branched annual herb, the prostrate stems 6 inches or less in length, bearing numerous small oblong or oval short-stalked flat leaves, ⅛ to ¼ inch long, either opposite or in whorls of 4's, herbage glabrous. *Flowers* very small, 1/12 inch long, grouped in dense many-flowered leafless clusters (cymes), each flower on its own short stalk, formed of a 5-parted calyx, the sepals keeled, green or purplish, white margined, 5 tissue-paper-like petals shorter than the sepals, 3 to 5 stamens, and central ovary which becomes a several-seeded capsule.

DISTRIBUTION.

Introduced European plant growing in beaten gravelly places, in the crevices of brick walks, etc., central and southern California (Santa Barbara).

PIGNUT.

(*Hoffmannseggia falcaria* Cav.)

DESCRIPTION.

Habit: Perennial herb with twice-compound glandular leaves and yellow flowers, the ascending or reclining stems 1 foot or less in height, leaves slender-stalked, grayish-green, their primary divisions 6 to 12 and these again divided into small paired (6 to 10 pairs) leaflets with an odd leaflet at the end of the primary seg-

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ment, leaflets ⅛ inch long or less, oblong and bluntly pointed; flowers in loose few-flowered racemes, the 5 petals nearly equal, rounded at the tip, free from each other, the ovary becoming a flat narrow usually curved pod, 1 to 2 inches long, hanging downward at maturity, containing about a dozen seeds.

DISTRIBUTION.

Native of the southwestern United States and now more or less of a nuisance in the Imperial Valley, its deep roots sending up new shoots after repeated hoeings.

TULE OR BULRUSH.

(*Scirpus occidentalis* Chase)

DESCRIPTION.

Habit: Perennial rush-like herb with stout creeping rootstocks and erect olive-green stems, the latter 3 to 10 feet high, round or obscurely 3-sided, sheathed below, leafless or with a single short round leaf at the end of the upper sheath; flowers in numerous red-brown spikelets grouped in a lateral umbel-like cluster 4 to 5 inches tall, each spikelet somewhat flattened, ¼ to ½ inch long, composed of overlapping scales, each scale with a minute flower composed of 6 bristles, 3 stamens, and central ovary, the latter becoming a gray lens-shaped achene, shorter than the bristles.

DISTRIBUTION.

The Tule is one of the characteristic plants of California, common in both brackish and fresh water throughout the state and often forming extensive "brakes"; a great nuisance along irrigating ditches in many sections.

Perhaps as common as the above and usually growing with it is another bulrush (*S. californicus* Britton), of the same general character but the achene longer than its bristles.

GERMAN KNOTGRASS.

(*Scleranthus annuus* L.)

DESCRIPTION.

Habit: Annual herb with long tough roots, much branched forking and spreading stems 2 to 4 inches long, small opposite, pointed and awl-shaped leaves, ¼ to ½ inch long, light green in color, their bases joined about the stem joints, and minute greenish-white flowers without petals, composed of 5 white-margined sepals united below, 5 or 10 stamens and central ovary which becomes a 1-seeded dry bladdery fruit (utricle), enclosed within the persistent calyx.

DISTRIBUTION.

Homely little weed, native of Europe, now found at one or two places along the west side of the Sierra Nevada; a common and troublesome weed in the eastern states.

YELLOW WATERWEED.

(*Jussiaea californica* Jepson)

DESCRIPTION.

Habit: Perennial glabrous aquatic or marsh herb with stout stems 1 to 6 feet long, alternate stalked leaves, 1 to 2 inches long, oblong or broader above the middle on the creeping stems but more or less circular in outline on floating stems and conspicuous deep yellow-stalked flowers solitary in the leaf-axils, each flower with an elongated calyx-tube formed of 5 sepals and enclosing the inferior ovary, 5 broadly

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oval petals, each ½ inch long, 10 stamens and very numerous seeds contained within the cylindrical spongy inch-long fruit, the last bearing upon its flat summit the 5 persistent pointed lobes of the calyx.

DISTRIBUTION.

Common in stagnant or slow-running water or along muddy banks in central and southern California; called "kelp" in the San Joaquin Valley.

Much resembling the preceding in aspect and habit of growth but with opposite leaves and the parts of the flower in 4's, the minute reddish petals generally missing when the plant is floating, is the Water Purslane (*Ludwigia palustris* Ell.), widely distributed in temperate regions of both the Old and New Worlds and found in central California north of San Francisco Bay.

YERBA MANSA.

(*Anemopsis californica* Hooker)

DESCRIPTION.

Habit: Perennial herb with thick aromatic rootstocks, hollow stems ½ to 2 feet high, basal bunched and few stem leaves, and small greenish-yellow flowers in dense cylindrical spikes, the last conspicuous because of the white (or purple-tinged beneath) waxy floral bracts, those of the lower flowers much larger and appearing like an involucre at the base of the spike; basal leaves 2 to 8 inches long, elliptical in shape, blunt at the tip with heart-shaped base above the leaf-stalk, the latter as long as the blade; stem with a clasping unstalked large leaf attached about midway, this leaf with a bunch of smaller stalked leaves in its axil; spikes ½ to 2 inches long, many-flowered, the flowers without calyx or corolla, stamens 5 or 6, and central ovary sunk in the fleshy axis of the spike, the ovary becoming a 1-celled capsule containing many small brown seeds. Flowering from March to August.

DISTRIBUTION.

Common herb of low salty lands throughout central and southern California, esteemed by the Spanish-Californians as medicinal.

CALIFORNIA FALSE HELLEBORE.

(*Veratrum californicum* Durand)

DESCRIPTION.

Habit: Coarse perennial herb, the tall stout leafy stem 3 to 6 feet high, more or less resembling a cornstalk. *Leaves* broad, folded, coarsely veined, sheathing the stem at base, ½ to 1 foot long and half as wide, the uppermost shorter and narrower. *Herbage* hairy. *Flowers* greenish-yellow, numerous and grouped in a terminal dense panicle about a foot long, the flower composed of 6 curved and flaring perianth segments (calyx and corolla together), each ⅓ to ⅔ inch long and nearly as broad, almost even-margined, 6 stamens, and central ovary, or the lower flowers in the panicle with ovary missing; ovary becoming a 3-celled capsule about an inch long, each cell with several flat winged seeds.

DISTRIBUTION.

Common in the higher valleys of the north Coast Ranges and Sierra Nevada; commonly regarded as poisonous by stockmen who generally call the plant "Skunk Cabbage" (a name which ought to be used for a quite different and foul-scented plant).

A closely allied species of northern California is *V. fimbriatum* Gray (Fringed False Hellebore), with perianth segments deeply fringed and capsule only ⅓ inch long.

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CELERY.

(*Apium graveolens* L.)

DESCRIPTION.

Habit: Biennial glabrous herb with fibrous roots, erect forking stems, 2 to 4 feet high, compound leaves, the lower long-stalked and composed of 5 to 10 leaflets, each leaflet 1 to 3 inches long and as wide or wider, coarsely toothed or even again divided, upper leaves short stalked or sessile, leaflets rarely more than 3; flowers white or greenish-yellow, grouped in compound 3 to 7-rayed umbels, sometimes with a leafy involucre at the base of the inch-long (or shorter) rays, each flower minute, its stalk very short, the inferior ovary becoming an egg-shaped finely 5-ribbed small fruit, scarcely 1/12 inch long, its ribs slightly winged.

DISTRIBUTION.

An escape from gardens common in low marshy places in central and southern California.

WATER-CRESS.

(*Radicula nasturtium-aquaticum* B. & R.)

DESCRIPTION.

Habit: Perennial smooth aquatic or marsh herb with floating or creeping branched and spreading stems which strike root at the joints, compound green leaves with 1 to 5 pairs of small leaflets and an odd larger terminal one, each leaflet roundish or oblong with nearly even margin, or the lowest leaves simple (the blade corresponding to the terminal leaflet of the compound leaves) and long-stalked and small but showy white flowers grouped in terminal racemes, each flower about ¼ inch broad, slender stalked, its petals twice as long as the sepals, the central ovary becoming a rounded pod, ½ to 1 inch long, many-seeded.

DISTRIBUTION.

Very common in streams, creeks, or about springs, especially in sunny places, throughout the state; native of Europe.

Two or three other species of this genus occur as fairly common plants, among them (1) *R. armoracia* Robinson (Horse-radish), an introduced Old World plant with large coarse root, erect stem 2 to 3 feet tall, usually very large simple oblong basal leaves, white flowers, and nearly round pods, the latter, however, rarely formed; and (2) *R. palustris* Moench. (March Yellow-cress), a plant of wet soil or growing in shallow water with erect branching stem 2 to 5 feet high, coarsely toothed or deeply lobed leaves, and small yellow flowers, the petals but slightly larger than the sepals; common along the lower Sacramento River.

PALE LAUREL.

(*Kalmia polifolia* Wang var. *microphylla* Rehder)

DESCRIPTION.

Habit: Low spreading shrub with slender branching stems 2 to 10 inches high, small shortly stalked, narrow leaves, opposite each other or rarely in 3's, ¼ to 1 inch long, smooth and deep green above, pale on the underside, the margins rolled, and lilac-purple flowers in small umbels at the ends of the branches, each flower on a slender thread-like flower-stalk and formed of 5 sepals, 5 petals united into a saucer-shaped corolla, about ½ inch across, 10 stamens shorter than the corolla and single pistil, the ovary becoming a many-seeded capsule. *Seeds* small, brown, nearly round.

DISTRIBUTION.

Sierra Nevada; justly feared by stockmen as a poisonous plant apt to be grazed in the meadows of the higher altitudes.

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COMMON REED.

(*Phragmites communis* Trin.)

DESCRIPTION.

Habit: Perennial water-reed with smooth stout leafy culms, 6 to 12 feet high, rising from long creeping jointed rootstocks or runners, sometimes 20 feet or more in length. *Leaves* ½ to 1 foot long or longer and about an inch wide, flat and glabrous, their sheaths loose and overlapping; flowers in spikelets grouped in terminal feathery panicles commonly a foot longer, dense and soft, usually purplish and sometimes nodding, each spikelet about ½ inch long, roundish, containing 3 to 7 flowers attached to the central axis of the spikelet, this axis with many long silky hairs at its joints.

DISTRIBUTION.

Cosmopolitan aquatic of fresh water swamps, stream and river banks, abundant in the Sacramento delta and occurring in southern California.

COW-PARSNIP.

(*Heracleum lanatum* Michx.)

DESCRIPTION.

Habit: Stout perennial with erect branching hairy and ridged stem, 3 to 5 feet high, sometimes an inch through at the base; large stalked green compound leaves, each formed of 3 leaflets, broadly lance-shaped in outline, 3 to 6 inches broad, rather thin, their margins lobed and sharply toothed, the leaf-stalks whitish and much inflated, sheathing the stem joints; flowers white, grouped in compound umbels, ½ to nearly a foot broad, the rays stout, numerous (10 to 30), 2 to 4 inches long, each supporting a small umbellet of 8 to 12 flowers, the heart-shaped petals unequal in the marginal flowers of the umbellet, their inferior ovaries becoming circular, flattened and winged fruits, each splitting at maturity into halves that are conspicuously marked by the 4 slightly curving oil-tubes reaching from the summit to about halfway of the side.

DISTRIBUTION.

Northern Coast Ranges and Sierra Nevada in moist shady canyons; generally regarded as poisonous to cattle but the evidence conflicting.

TAWNY BEARD-GRASS.

(*Polypogon monspeliensis* Desf.)

DESCRIPTION.

Habit: Annual grass of moist soil with smooth leafy culms ½ to 2 feet high, erect or ascending. *Leaves* with flat blades, 2 to 6 inches long and ¼ inch wide or narrower, their sheaths loose. *Flowers* in spikelets grouped in soft compact spike-like tawny or yellowish panicles 1 to 6 inches long, each spikelet 1-flowered, its empty scales (glumes) bearing straight slender awns which give the bristly appearance characteristic of the flower cluster of this very abundant introduced weedy grass; native of Europe, so commonly found along irrigating ditches or in over-irrigated tilled land from one end of the state to the other.

DISTRIBUTION.

A related grass, which is also fairly common throughout the same range and in about the same places as Tawny Beard-grass, is Water Beard-grass (*P. lutosus* Hitch.), a perennial with less compact or often lobed panicle, the awns of the glumes about 1/12 inch long, only half as long as the awns of the first species.

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TIBINAGUA.

(*Eriogonum nudum* Douglas)

DESCRIPTION.

Habit: Perennial tall slender-stemmed herb, 1 to 3 feet high, the gray-green naked stem forking regularly above the basal cluster of broadly oval stalked leaves, ½ to 2 inches long, their tips broadly rounded and bases squarrish or even heart-shaped, the margins wavy, densely gray-hairy beneath, more or less so above; stem often inflated just below the first fork. *Flowers* small, usually white but sometimes rose-color or yellowish, grouped in clusters within an involucre, several of such involucres bunched in heads at the joints or tips of the stem. *Ovaries* becoming triangular achenes.

DISTRIBUTION.

Very common in dry land, especially in hills and mesas, of central California and the interior of southern California, quite variable, some of the forms growing in the high mountains and then much reduced in size and number of flowers.

A related plant is the famous Wild Buckwheat (*E. fasciculatum* Bentham), a shrubby species growing in the chaparral from Monterey County southward and of great value as bee forage; flowers white grouped in large flat-topped clusters at the ends of the stem branches, leaves narrow, revolute.

WATER HYACINTH.

(*Eichornia crassipes* Solms)

DESCRIPTION.

Habit: Perennial floating herb with short erect stems about a foot high, simple very narrow (linear) submerged and broader emerged tufted leaves, the latter with leaf-stalks conspicuously inflated and serving as floats to support the plant on the water surface and pale violet flowers grouped in few-flowered terminal spikes; roots of 2 kinds: longer and slender vertical ones, thickly covered with small black fibrous branch-roots, and thickish fleshy horizontal roots spreading through the water at the base of the stems. *Flowers* composed of 6 perianth-segments (calyx and corolla combined) united below into a funnel-shaped tube, their lobes free, unequal, the large upper lobe with a patch of bright blue having a bright yellow spot in its center, stamens 6, their curving stalks unequal, three longer than the others, and single central ovary which ripens to a 3-celled capsule containing many seeds.

DISTRIBUTION.

Beautiful aquatic frequently grown as an ornamental in water-gardens and escaped in the southern states where it has become a most serious pest, blocking the streams and impeding navigation; naturalized in a few places in California: lower Sacramento Valley (Yolo County near Clarksburg), in Fresno County (branches of Kings River near Centerville), San Bernardino County (on Warner Creek).

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CAMEL'S THORN.

(*Alhagi camelorum* Fisch.)

DESCRIPTION.

Habit: Low spiny shrub with much-branched stems 1 to 3 feet high, small scattered deciduous leaves, arranged alternately upon the stem branches, their entire blades bluntly tipped, ½ to 1 inch long and about one-third as broad, and numerous small red flowers grouped in few-flowered racemes in the leaf-axils of the terminal branches, each flower shaped like that of a sweet-pea, its corolla about ⅓ inch in length, the single ovary becoming a few-seeded cylindrical pod contracted between the seeds; seeds kidney-shaped.

DISTRIBUTION.

Native of southwestern Asia and occasionally grown as an ornamental; escaped in California or perhaps accidentally introduced with nursery stock and now established in southern California as a nuisance in the date groves about Mecca and Indio; reported from the Sacramento Valley.

ORCHARD GRASS.

(*Dactylis glomerata* L.)

DESCRIPTION.

Habit: Tall perennial with creeping rootstocks and erect stout culms 2 to 4 feet high, forming dense tufts. *Leaves* with flat blades 3 to 8 inches long and ¼ inch wide, both blade and sheath harsh with short stiff hairs. *Flowers* in somewhat compressed spikelets, the latter shortly stalked and densely bunched in fascicles at the ends of the branches of the terminal panicle; panicle 2 to 6 inches long, its branches widely spreading, somewhat reddened at the time of flowering; spikelets 3 to 5-flowered (rarely 1-flowered), the empty scales (glumes) unequal and flowering scale (lemma) awn-pointed.

DISTRIBUTION.

Native of Europe and cultivated in some sections of the eastern states as a meadon grass; escaped on the Pacific Coast and often weedy in waste places or on rich tilled land, also along roadsides.

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WEEDS OF CALIFORNIA

AND

METHODS OF CONTROL

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WEEDS AND THEIR HABITS.

By ETHELBERT JOHNSON, Sacramento, California.

The variations of climate in California induce a distinct type of agricultural problems not found in any other state. While many states have investigated the subject of weeds and weed control, the results frequently are not applicable to California. For example, the troublesome quack grass (*Agropyron repens*) of the Eastern States, must have been introduced many times into California, yet it has nowhere in this state become a serious weed pest. Again, there is perhaps no other state that would include the cultivated radish (*Raphanus sativus*) among its noxious weeds, yet over a large section of California it has escaped from cultivation and has become as troublesome as its relative, the weedy, wild radish (*Raphanus raphanistrum*), of eastern North America and Europe.

The weed problem in California is a serious one. With extensive farming long prevalent, with overstocking of pastures practiced since early in the history of the state, with moderate winters over the greater part of its area, all of which combined enable many annuals and biennials to become perennials the weed flora has increased to a remarkable extent. Dr. P. B. Kennedy estimates that on the average three new weeds are introduced annually into California, one of which is noxious.

In a state extending through ten degrees in latitude and in altitude from three hundred feet below to fourteen thousand feet above sea level, with every form of shelter and exposure, every type and condition of soil and every variation of moisture supply, it would be indeed strange if any vagrant plant could not find a congenial habitat.

In view of these peculiar conditions, it is unfortunate that so little has been done to investigate the California weed problem. We have a record of but two experimental investigations, both on the subject of the eradication of morning-glory (*Convolvulus arvensis*).[1]

Any investigation directed toward the eradication of a weed, whether by mechanical means or by the use of chemical herbicides, must be preceded by a thorough study of its life history and habits in order that intelligent use may be made of the means at hand to attack the weed in its most vulnerable stage. After the life history has been studied it is possible to formulate a set of rules for control or eradication which should be scientifically correct. Since no extensive scientific investigations have been carried out in California it should be understood that the authors have no intention in suggesting control measures for weeds mentioned in this bulletin or giving out rules based on the results of careful experimentation. In cases where experiments have been tried elsewhere there is no assurance that the results are applicable to California conditions. However, there are certain general statements which can be relied upon to bring results with most annuals and some perennials.

The most effective way to attack the weed problem is to begin at its source. It is of little avail to study how to exterminate weeds if the

[1]California Agricultural Experiment Station Circular 69, The Extermination of Wild Morning-glory; and Circular 168, Spraying for the Control of Wild Morning-glory in the Fog Belt.

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practice is followed year after year of sowing the seeds of these same weeds on the land as impurities in agricultural seed. The successful operation of the Pure Seed Law passed by the last Legislature is the first and most important step in a state-wide attempt at a solution of California's weed problem.

WHAT IS A WEED?

In the commonly accepted sense of the term, a weed is an intrusive, injurious, or unsightly plant. Most of our troublesome weeds are aliens which have been introduced in various ways and which find their new environment congenial; but there are a few native plants which find the conditions in fields, meadows, or pastures so favorable to their propagation that they are able successfully to compete with more desirable plants.

WHAT ENABLES A PLANT TO BECOME A WEED?

Seeding Habits.

1. Some plants produce an enormous number of seeds (see Table I).
2. The seeds of some plants are able to sprout after being buried many years in the soil (see Table II).
3. Some plants are capable of storing a sufficient amount of water and plant food to enable them to mature seeds even after being pulled (purslane).
4. Some weeds can mature their seeds and scatter them before the crop is harvested (mustard, in barley); others mature their seed at the same time as the crop and are harvested with it (dodder, in alfalfa). Often the seeds are of about the same size as those of the crop, and are difficult to separate (goosefoot, in alfalfa).

TABLE I. *Number of Seeds Per Plant Produced by Some Common Weeds.*

Tumbleweed, *Amaranthus*	6,000,000
Tumbling mustard, *Sisymbrium*	1,500,000
Water-grass, *Echinochloa*	980,000
Mullein, *Verbascum*	900,000
Lamb's-quarters, *Chenopodium*	608,000
Yarrow, *Achillea*	578,000
Horse-weed, *Erigeron*	324,000
Prickley lettuce, *Lactuca*	243,000
Crab-grass, *Digitaria*	204,000
Russian thistle, *Salsola*	200,000
Winter cress, *Barbarea*	200,000
Curled dock, *Rumex crispus*	144,000
Black mustard, *Brassica nigra*	143,000
Green foxtail, *Setaria viridis*	142,000
Buckthorn, *Plantago lanceolata*	118,000

TABLE II. *Viability of Seeds of Some Common Weeds.*

More than 30 years—
- Shepherd's purse, *Capsella.*
- Mustard, *Brassica.*
- Purslane, *Portulaca.*
- Pigeon grass, *Setaria.*
- Pigweed, *Chenopodium.*
- Mayweed, *Anthemis.*
- Dock, *Rumex crispus.*
- Chickweed, *Stellaria.*

More than 25 years—
- Prickly pigweed, *Amaranthus retroflexus.*

5 to 10 years—
- Mallow, *Malva.*

Less than 5 years—
- Ragweed, *Ambrosia.*
- Corn-cockle, *Agrostemma.*
- Cheat, *Bromus secalinus.*
- Plantain, *Plantago.*

20 to 55 months—
- Wild oats, *Avena.*

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5. Some plants have special provisions to take advantage of natural agencies in distributing their seed.

Habits of Growth.

1. Some plants are inconspicuous and are not noticed until they have become abundant (shepherd's purse). Some produce inconspicuous flowers and go to seed before they are suspected (goosefoot).
2. Some plants protect themselves by sharp spines (thistles).
3. Some plants are capable of forming new plants from pieces of the old plant (Bermuda grass).
4. Some plants have creeping, underground parts (morning-glory, Johnson grass).
5. Some weeds have a disagreeable odor (stinkweed [*Gilia squarrosa*]).
6. Many weeds have an unsightly appearance (cocklebur). Some plants exude a viscid substance which stains clothing, collects dust, and gives them an ugly appearance (tarweeds).
7. Many plants are distasteful to stock and are left to occupy the ground undisturbed (horse mint).
8. Many weeds are more vigorous than the crop, better able to gather food and moisture and more readily adaptable to adverse conditions of soil, climate, or environment.

LOSSES CAUSED BY WEEDS.

Decreased Yields.

1. Weeds rob the soil of moisture and plant food that is needed for more valuable plants, and consequently reduce the yield. (See Tables III and IV.) Plants with a large leaf surface usually take more moisture than plants with less leaf surface.
2. Weeds occupy space needed by the crop, interfering with top growth and root development (see Table V), often stunting the growth and causing uneven ripening, all tending to reduce the yield. Rice fields frequently have been abandoned because of the presence of water grasses.
3. Some weeds are parasitic on certain crops, like the dodder on alfalfa.
4. Some weeds reduce the yield by dragging down the crop so that it can not be harvested by ordinary methods (bindweed, *Polygonum convolvulus*).

TABLE III. *Water Requirement of Certain Weeds and Crops.*[1]

Pounds of water required to produce one pound of dry matter:

	Pounds		Pounds
Ragweed, *Artemisia*	948	Alfalfa	831
Goosefoot, *Chenopodium*	801	Sweet Clover	770
Sunflower, *Helianthus*	683	Oats	597
Rosin-weed, *Grindelia*	608	Barley	534
Russian thistle, *Salsola*	336	Wheat	513
Pigweed, *Amaranthus*	287	Corn	368
		Sorghum	323

[1]Transcribed from Colorado Agricultural Experiment Station Bulletin 251.

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TABLE IV. *Fertility Elements Removed by One Ton of Certain Weeds and Crops.*[1]

	Nitrogen, pounds	Phosphoric acid, pounds
Goosefoot, *Chenopodium*	16.8	3.4
Ragweed, *Ambrosia*	14.6	3.0
Wild oats, *Avena*	13.0	2.6
Pigweed, *Amaranthus*	11.2	3.0
Water grass, *Echinochloa*	8.3	3.2
Purslane, *Portulaca*	6.7	1.7
Wheat	12.2	2.8
Oats	10.8	3.0
Barley	18.4	5.0

5. Weeds reduce the value of the product. Grain or seed containing weed seeds is docked on the market. If not removed from wheat, some weed seeds such as bitter clover (*Melilotus indica*) make the flour unfit for use. A few seeds of dodder in alfalfa seed renders it unfit for seeding purposes. Some weeds like wild onion (*Allium*) in hay or feedstuffs when eaten by live stock give to dairy or poultry products an objectionable taste; and others like pennycress give a disagreeable taste to meat.

Increased Cost of Operations.

1. Some weeds stop up ditches and drains, interfering with irrigation and drainage (cat-tails, *Typha*).
2. Weeds increase the cost of cultivation. The United States Department of Agriculture in a series of experiments showed that the principle, and in some sections perhaps the only, value of cultivation in corn is to remove weeds (Bureau of Plant Industry Bulletin 257).
3. Weeds increase the cost of harvesting the crop by requiring more time, more power, or more labor; and by increasing the wear and tear on machinery.
4. Weeds may delay the curing of hay or the drying of grain.
5. Weed seeds in grain cost the farmer freight on material for which he receives no returns, as well as the expense of separating.
6. Weeds may interfere with the regular system of rotation.

Injurious Effects.

1. Some weeds are poisonous to animals or to humans.
2. Some weeds are capable of inflicting mechanical injuries on stock as in the case of foxtail, turkey mullein, etc.
3. Some weeds may tear by their sharp spines.
4. Some weeds cause hay fever, particularly those with inconspicuous flowers which are wind pollinated (Ragweed, *Ambrosia*). *See* Cal. Hort. Com. Mo. Bulletin, Vol. VI, No. 2, February, 1917.
5. Weeds harbor plant pests. Nightshade harbors a number of species of the scale insects so troublesome in citrus orchards. Mustard furnishes an ubiquitous host plant for the cabbage aphis, club root of turnips, and other pests of Crucifers. Several weeds serve as winter hosts of the almond mite or red spider. In some states grain rust has been practically exterminated by a campaign to eradicate the barberry, *Berberis,* which carries the rust over from one crop to the next.

[1]Transcribed from North Dakota Agricultural Experiment Station Bulletin 112.

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The loss to the United States from grain rust in 1919 is estimated by the United States Department of Agriculture as follows:

Wheat 53,000,000 bushels.
Oats 17,400,000 bushels.
Barley 4,700,000 bushels.

In 1916 the loss of wheat was estimated at 200,000,000 bushels. The following states, in cooperation with the United States Department of

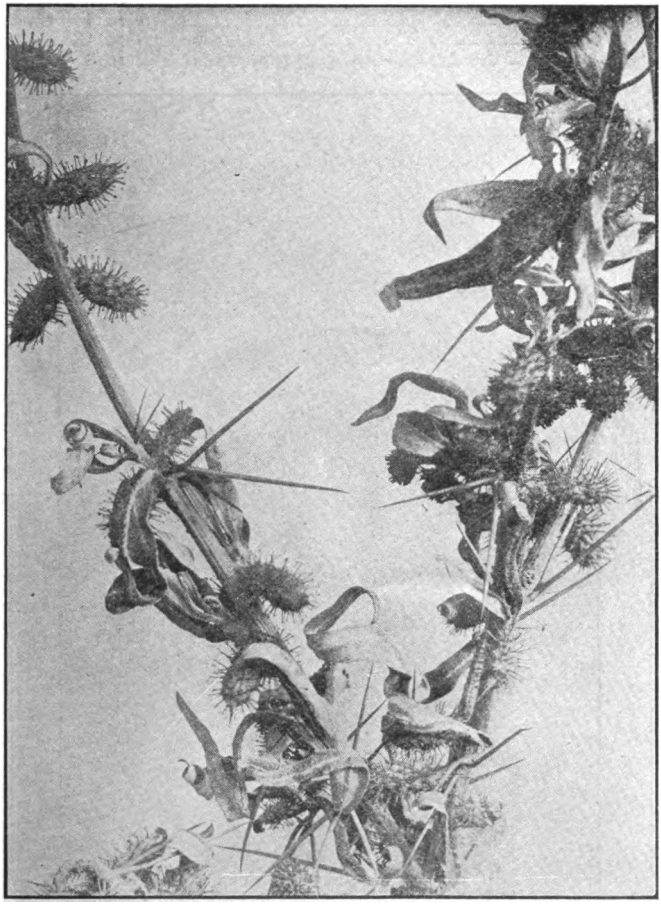

FIG. 117. The spiny clot-bur, *Xanthium spinosum*, is a widely distributed weed. Its sharp spines injure stock, and its burs become entangled in the wool of sheep and goats.

Agriculture are engaged in barberry eradication campaigns: Colorado, Indiana, Illinois, Iowa, Ohio, Michigan, Minnesota, Montana, Nebraska, North Dakota, South Dakota, Wisconsin, Wyoming. (U. S. Department of Agriculture News Letter, Vol. VII, No. 31).

Many diseases and insect pests of cultivated crops are carried over by weeds in fencerows and on ditch banks nearby. Even though they

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do not themselves become infested, neglected weeds may by their rank growth offer conditions of shade and moisture favorable to the development of bacterial and fungous diseases and insect pests.

TABLE V. *Root Penetration of Certain Weeds.*[1]

	Depth, inches[2]	Spread, square inches[2]
Cocklebur (*Xanthium canadense*)	4 to 10	425
Horseweed (*Erigeron*)	7 to 14	144
Pigweed (*Amaranthus*)	7 to 14	144
Nightshade (*Solanum*)	1 to 4	80
Knotweed (*Polygonum*)	1 to 4	45
Plantain (*Plantago*)	3 to 13	30
Mayweed (*Anthemis*)	2 to 3	4

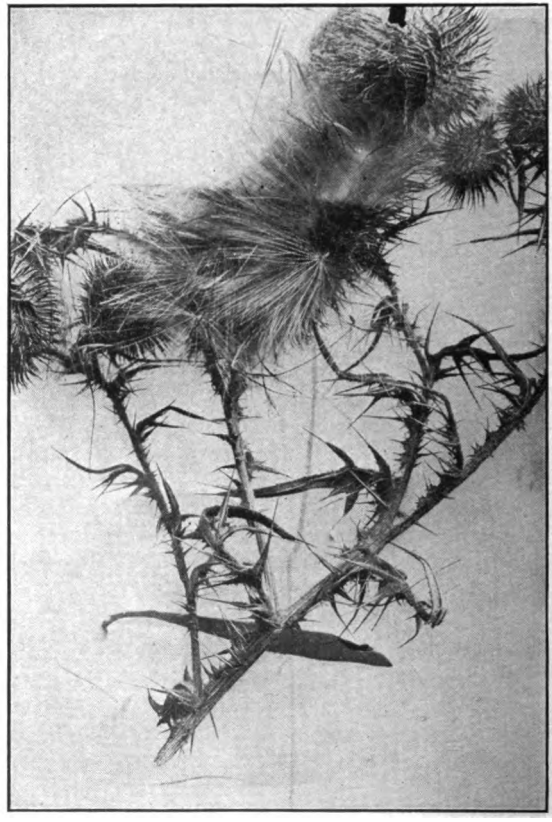

FIG. 118. A floral branch of the bull thistle (*Cirsium lanceolatum*): The seeds are attached at the base of long, feathery appendages which enables them to be transported far and wide by the fall winds.

6. Weeds reduce the value of land.

7. Weeds are demoralizing. The appearance of a farm is often an indication of the character of its operator.

[1]Transcribed from Weeds of Farm and Garden, L. H. Pammel.
[2]Under Iowa conditions. The deeper soils of California permit of greater root development than is here indicated.

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BENEFITS FROM WEEDS.

1. Weeds supply humus when turned under as a cover crop.
2. Weeds prevent erosion.
3. A number of weeds are used in medicine (see U. S. D. A. Farmer's Bulletin No. 188).
4. Some weeds make good forage.
5. New uses are continually being found for plants hitherto considered worthless weeds.
6. Weeds necessitate tillage, which is the basis of good agricultural practice.

HOW WEEDS SPREAD.

I. By Seed.

Many plants have special provisions which enable them to take advantage of natural agencies in disseminating their seed.

Wind.

1. Tumble-weeds. Some weeds make a light, bushy growth, and when mature break off from their roots and are rolled along by the wind, dropping seed as they go (Russian thistle).

2. Appendages to the seed or fruit. Some seeds have feathery appendages (sow thistle, *Sonchus*); some have wing-like projections

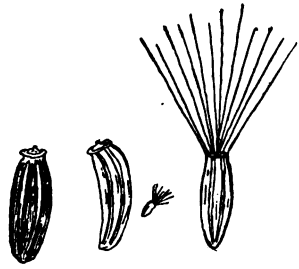

FIG. 119. Canada thistle (*Cirsium arvense*): Seeds are spread by wind.

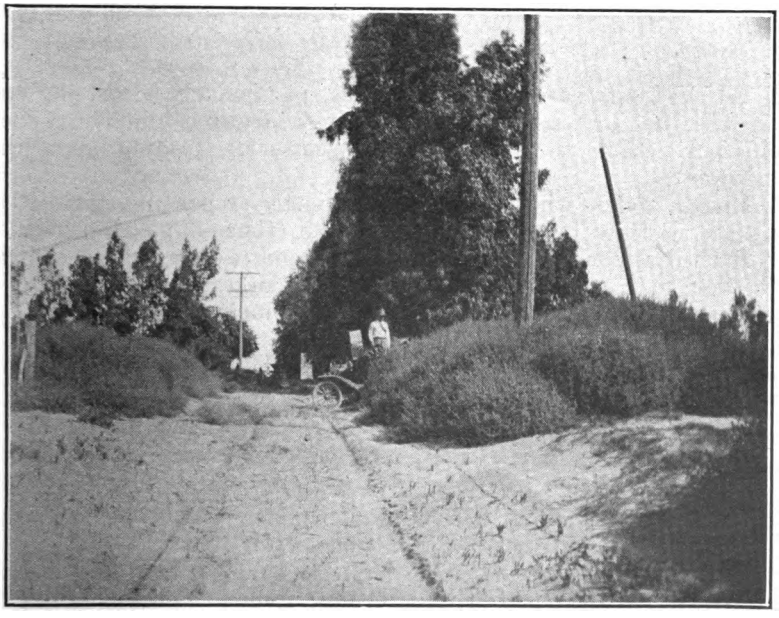

FIG. 120. Russian thistle (*Salsola kali* var. *tragus*): Along roadside in southern California.

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(spurry, *Spergula arvensis*); a few others have inflated attachments (balloon vine, *Cardiospermum*). All these provisions assist the seed in being carried by the wind.

3. Mucilaginous seed coats. Some seeds become sticky when moist, and adhere to dead leaves which are blown about by the wind (plantain).

4. Minute seeds may be carried for a considerable distance in the wind (broom-rape). Even heavier seeds may be transported a considerable distance. It was found that a wind blowing at the rate of twenty-five miles per hour carried wheat thirty rods in one minute (N. D. Agr. Exp. Sta. Bulletin 17).

Water.

1. Inflated appendages. Some seeds have a light, hollow covering which enable them to float (dock).

2. Mechanical transportation. Running water often carries for a long distance seeds of plants growing along streams or ditches (water grass, *Echinochloa*).

Automatic Movements.

1. Expelled seeds. The dry pods of some plants suddenly twist, scattering the seeds (vetch). The mature fruits of some plants burst suddenly, expelling the seed (wood sorrel, *Oxalis*).

2. Self-burying seeds. Some seeds bear an appendage which twists and untwists according to the humidity, the twisting movement causing the seed to burrow into the soil (filaree).

Animals.

1. Edible fruits are eaten by animals, particularly birds, the seeds being discarded or passed in the droppings (trailing bramble). Some plants have edible seeds which birds scatter in feeding upon them (sunflower).

2. Elastic stalks, when brushed by animals or persons, spring back into place, casting the seed a short distance (thorn-apple, *Datura*).

3. Barbed appendages on the seeds of some weeds become attached to the fur, hair, or wool of animals or the clothes of persons, and are carried away to infest new territory (cocklebur).

II. By Pieces of the Plant.

A number of perennials, besides producing seed, are capable of propagating vegetatively.

Underground Parts:

1. Creeping roots may become independent plants by separation from the parent plant (sorrel, *Rumex acetosella*).

2. Creeping underground stems. Stems spring from buds beneath the leaf-scales at the nodes of underground stems. Roots usually occur also at the nodes, and by separation from the parent plant become new plants (Johnson grass).

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3. Tubers. Thickened portions of the underground stem store food material and are capable of producing new plants (nut grass, *Cyperus esculentus*).

4. Bulbs and corms are produced at the base of the parent plant and may produce new plants (death camas).

5. Adventitious buds are produced from the upper portion of the vertical root, or buds may be sent up from the cut root (dandelion).

Parts Above Ground:

1. Creeping stems. Prostrate stems may produce roots at the nodes, becoming independent plants when the connection with the parent plant is severed (Bermuda grass).

2. Buds from the crown are capable of reproducing some plants. As the crown enlarges, part of the root may decay, leaving a number of separate plants (dock).

3. Small bulb-like parts which readily reproduce are formed from the vegetative portions of the flowers of the wild onion (*Allium vineale*).

HOW WEEDS ARE INTRODUCED INTO NEW LOCALITIES.

Besides the natural means of reproduction, weeds can be introduced to the farm in many ways.

1. Through the use of impure seeds.

2. Railways introduce new weeds into land adjacent to the right of way. Weed seeds leak out of cars when transporting grain or seed in bulk. Stock en route is often fed screenings or bedded with straw containing large numbers of weed seeds. Many of these seeds drop along the way, many pass through the digestive tract uninjured and are thrown out with the manure when the stock cars are cleaned, and many are left at the loading and unloading corrals. The introduction and spread of the puncture vine, *Tribulus terrestris,* in California is directly traceable to the railroads.

In making fills or building embankments, dirt from other localities is often transported, and with it the weed seeds it contains. Often railroad embankments are sown with low grade seed containing weed seed, in order to prevent erosion. Most railway companies attempt to control the weeds along their right of way, but often this is not done at the proper time to prevent seeding, and as a result the weeds gradually spread to the surrounding country.

3. Mud and dirt containing weed seeds may be picked up by vehicles, or by the feet of stock or persons.

4. Threshing machines, hay presses, and harvesters if not thoroughly cleaned, carry weed seeds from one farm to another. The combined harvester is one of the worst enemies to clean fields in California, for not only does it transport weed seeds over the country, but it returns to the land the weed seeds separated from the grain.

5. Cultivation separates the parts of weeds capable of vegetative reproduction, and assists them to spread.

6. Packing material used in shipping nursery stock may contain weed seeds.

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FIG. 121. Burs of the ground bur-nut or Caltrop (*Tribulus terrestris*) sticking in an automobile tire. The writer has carried some of these seeds attached to the tires of his machine for over two miles.

7. Some plants cultivated for ornamental or economic purposes may become weeds; Johnson grass, *Holcus halepensis,* was introduced as a forage plant; and radish, *Raphanus sativus,* is an escape from truck gardens.

8. Manure often contains many viable weed seeds, due to the feeding of grain, screenings, or hay containing weed seeds.

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SUGGESTIONS FOR CONTROLLING WEEDS IN CALIFORNIA.

By O. W. NEWMAN and ETHELBERT JOHNSON, Sacramento, California.

Few of the preventive and remedial measures here offered are based upon actual experimental work under California conditions. Until systematic investigational work in this state is taken up, we must content ourselves with reiterating the advice and experience of other states.

There is no easy way to eradicate weeds, but there are a few fundamental principles which should be kept in mind when any attempt is made to destroy weeds:

1. All plants are killed more readily when young. So apparent an observation may seem unnecessary until one considers the vast amount of time and money that is expended each year in the attempt to destroy full-grown weeds when earlier in the season the tiny plants might have been readily killed with a minimum of effort and cost.
2. Many species may be destroyed by preventing the plants from forming seed.
3. Most plants will be exterminated if persistently prevented from forming green leaves.
4. Most weeds are more easily killed just before flowering.

WEEDS CAN BE CONTROLLED.

The control of weeds is primarily a community problem but there are a number of precautions an individual may take to prevent the introduction and spread of noxious weeds on his land.

1. *Sow Clean Seed.* No seed but the best is good enough to sow. Clean seed usually can be obtained from established dealers. Samples of seed are examined free of charge for impurities and for viability by the Seed Laboratory, State Department of Agriculture, Sacramento, California.

2. *Study the weeds* and their habits, in order to be able to attack them at their most vulnerable stage.

3. *Protect the birds* which destroy weed seeds.

4. *Screenings* always contain many weed seeds, and the greatest care should be exercised in disposing of them if an infestation of weeds is to be avoided. Many of these seeds will grow after passing through the digestive tract. In order to destroy weed seeds, screenings and feedstuffs may be ground, boiled, or steamed before feeding, or the manure may be composted before spreading on the land. A law in Utah prohibits the feeding of sweepings and screenings unless they have been treated. All screenings and sweepings not so treated are to be burned.

5. *Harvesters, threshers, mills, haypresses* and other machines which are moved from place to place to handle crops should be thoroughly cleaned before moving from one field to the next. This is required by law in many states.

6. *Fencerows,* ditch banks, and other waste lands should be kept cleared of objectionable weeds.

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7. *Fall plowing* to stimulate the germination of weed seeds is a good practice, if followed up by tillage at the proper time to kill the young weeds.

8. *Sheep and goats* will help keep down weeds where cultural practices are difficult. Unringed hogs will destroy the fleshy underground parts of many weeds.

9. *Rotation* is the best way to keep fields clean. The rotation best for weed control generally will contain an intertilled crop and a dense shading crop.

10. *Manure* is much less objectionable as an agent for distributing noxious weed seeds if composted before applying to the land.

WEED CONTROL IS A COMMUNITY PROBLEM.

A farmer who would try to keep his fields clean is discouraged when his neighbor permits weeds to go to seed and reinfest the land which has been cleaned with so much labor and expense. It is unfortunate that much of the most important work in weed control comes at a time when the farmer is busiest with his harvest. The attitude that weed control is of secondary importance only, gradually results in increased costs and decreased yields. That it is possible to have farms and whole communities practically free from weeds is borne out by the fact that the best farmers are least troubled with weeds.

The rural school can be made one of the great forces for good farming practice and clean fields. Not only does it instruct the coming generation, but it can interest the parents in the necessity for community action.

1. The children may bring to school troublesome plants for identification. If the teacher is unable to identify the plants, they should be sent to the State Department of Agriculture, at Sacramento, or to the Botanist of the Agricultural Experiment Station, at Berkeley.

2. The collection and mounting of weeds will be of value not only in educating the children, but in assisting the farmers of the community in identifying local weeds.

3. A collection of weed seeds, properly labeled, is of inestimable value to any rural community. Seed of local weeds can be collected at the proper time, and the collection can be augmented by seeds from samples taken from commercial seed. A satisfactory way to keep weed seeds is in homeopathic vials. The label may be pasted on the outside of the vial, or may be slipped inside. The label should include the scientific name, the local common name, the date of collection, the locality or source and the collector's name. Seeds which can not be identified should be sent to the Seed Laboratory, State Department of Agriculture, Sacramento, California.

4. Seed testing is an instructive and practical study, and can be made of great value to the community.

5. Children should be taught to know and protect the beneficial birds.

6. A children's weed club can be made interesting and instructive. In one such club, with which the writer has had some experience, each member agreed to destroy at least one noxious weed a day. In another, each member was assigned a particular weed and agreed to destroy it whenever he met with it.

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7. An interesting plan was tried out in an Australian community. A new weed, *Senecio jacobaea,* had become established and its rapid spread was alarming the farmers. A prize was offered to the child bringing in the greatest number of plants of this weed. In this way 20,000 plants were collected and destroyed in a few days and the weed was practically exterminated.

THE BASIS OF WEED CONTROL METHODS.

Life History Study.

In order to be able to attack a weed at the most vulnerable stage, it is necessary to know its life history and habits of growth. Plants, according to their length of life, are either annuals, biennials or perennials.

Annuals live only one year, maturing their seeds and then dying. This term is usually applied to weeds which germinate in the spring and mature their seeds in the summer or fall of the same year.

Winter annuals germinate in the fall and mature their seeds in the summer of the succeeding year; e. g. mustard,

Biennials live for two years. The first year is devoted to storing up plant food in a fleshy root and the second year to maturing the seed. Examples of this class are the wild carrot, bull thistle and others.

Perennials live for more than two years, producing top growth and usually maturing seed each year. They may be more or less stationary, or may have creeping stems or underground parts which are capable of producing new plants.

Control of annual and biennial weeds is based on preventing seed production and preventing the introduction of new seeds to the farm. In the control of perennials, this is not sufficient; in addition steps must be taken to destroy the underground parts. This may sometimes be accomplished by preventing top growth, which, since plants are dependent on the food material furnished by their green leaves, ultimately starves out the underground part.

While it is of great value to know whether a plant is an annual, biennial, or perennial, much more must be known in order to make the most intelligent use of control means. Little or no attention has been given to the life history of weeds under California conditions. Such a study must necessarily involve accurate observation of such details as the distribution and usual plant associations; the typical habitat; soil and moisture preferences; the habit of growth and character of the herbage; the root system, its type, depth and spread; the flowers, how and when the stalks are formed and how and when fertilization takes place; the seeds, when matured, how and when disseminated; the season when seed germinates under natural conditions; the period of incubation to induce germination; and germination tests of mature and immature seeds.

TILLAGE OPERATIONS TO CONTROL WEEDS.

Creeping perennials require careful attention, since they have the ability to form new plants from pieces of the old plant. If cultivation is indifferently or unintelligently performed it will serve only to

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increase the infestation. Generally, the best cultural method to follow in the control of such weeds is to plow shallow, follow with a spike-tooth harrow and rake the roots together and burn them. Sometimes it is sufficient to expose the cut roots to the sun and wind or to the frost. Persistent cultivation to prevent the formation of green leaves will soon starve out the roots of most weeds of this class.

Bare fallow, while affording perhaps the easiest way of controlling weeds by tillage operations, is of doubtful value where not necessary for the conservation of moisture. It is far better to keep the land occupied and keep down the weeds by cultivation. However, there may be instances such as a one-crop project where no other crop can profitably be grown and where the proceeds have been greatly reduced by the prevalence of weeds.

Plowing in the fall to germinate the weed seeds, followed by thorough preparation of the land in the spring, is effective in controlling weeds, but many weed seeds if buried deep are capable of germinating after many years when brought again near the surface.

Harrowing before and just after planting will kill many seedling weeds. The use of the spike harrow after planting is a common practice in growing grain, corn, beans and other field crops.

Disking in the preparation of the seed bed destroys many weeds but in the case of most creeping perennials, the disk may tend rather to assist in spreading the weed, since each piece of the chopped root is capable of producing a new plant.

Cultivating in orchards and intertilled crops is one of the best opportunities to control weeds. The ordinary shovel teeth are not so effective in destroying plants as are the V-shaped sweeps or weed knives. Cultivation, to be effective, must be thorough and must be continued as long as the size of the crop permits.

CUTTING TO CONTROL WEEDS.

Mowing to be effective in controlling weeds must be done at the proper time, which ordinarily will be not later than the time when the flowers reach full bloom. Some plants, however, are capable, when cut off, of growing up again as luxuriantly as before (lettuce); some, if cut repeatedly, are capable of forming dwarf plants, which bloom and form seed too low to be reached with the mower (radish). A mowing after the crop is off in order to prevent the weeds from going to seed will help to reduce the stand of weeds for the succeeding season.

Hand work is practical where a weed is just becoming established; where objectionable weeds occur singly or in isolated patches; where eradication by other methods is nearly complete; or when the actual cost of the operation is a minor item, as in the eradication of poisonous plants in pastures. The principal tools used in hand eradication are various types of hoes, spades, scythes, brush hooks, spuds, weed grubs, weeding forks, mattocks and hand cultivators, each of which has its special use. Judicious cutting, if repeated often enough, will destroy most weeds.

Grazing animals. Some weeds are the least palatable constituents of a pasture, and stock pass them by (goat weed). Frequently, how-

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FIG. 122. The ground bur-nut, or Caltrop (*Tribulus terrestris*), showing burs left on the ground after the foliage has been removed. The importance of controlling this pest at the beginning of the growing period is apparent. (Photo courtesy Fred P. Roullard.)

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ever, sheep and goats are effective in keeping down weeds and unringed hogs will root out and destroy the succulent underground parts of some of the most troublesome perennials.

SOIL IMPROVEMENT TO CONTROL WEEDS.

Many weeds can not compete with other plants on good soil but crowd out the crop on poor soil. The application of manure, fertilizers, or lime, by improving the physical or chemical condition of the soil, stimulates the growth of the crop and enables it better to compete with the weeds.

Some weeds grow characteristically in acid soil, and disappear when lime is applied (sour dock, *Rumex acetosella*). Some weeds of low, wet places disappear when the soil is properly drained (cat-tails, *Typha*). In general, any pronounced change made in the physical or chemical condition of a soil tends to change the character of its flora. This fact should afford a fascinating subject for investigational work in weed control.

BURNING TO CONTROL WEEDS.

If burning of weeds is delayed until they have matured and become dry, the seeds will have been scattered. Weeds which have been cut green should in most cases be piled and burned as soon as dry, as some weeds are able to store enough plant food and moisture to mature their seeds after they have been cut (purslane). Various types of weed torches have been tried for burning weeds on a large scale but are not to be recommended on agricultural lands because of the destruction of humus, a constituent particularly precious in most California soils.

SMOTHERING TO CONTROL WEEDS.

To check noxious perennials which occur only in small patches, it is sometimes practicable to smother them by covering with tarred roofing paper, manure, straw, or other materials which exclude light.

A heavy stand of a vigorous growing crop will choke out some weeds. Alfalfa and sudan grass are particularly valuable for this purpose as are also cowpeas, corn or sorghum grown for silage or soiling, Rhodes grass, Napier grass, and sweet clover.

NATURAL ENEMIES OF WEEDS.

Weeds, unfortunately, are so closely related to crop plants that it is rarely a pest can be found that will attack the weed without attacking some crop. Indeed, weeds are in most cases so much more hardy than the crop that the crop is likely to be injured more than the weed.

Fungi. A rust has been found which preys upon the Canada thistle, *Cirsium arvense* but it has not proved of importance in preventing the spread of this pest in the eastern states. A parasitic growth has been found on the water hyacinth (*Eichornia crassipes*) in Florida but the plant propagates so rapidly that the parasite has so far proved of little value as a practical method of checking the pest. Several fungi are being experimented with in Australia for controlling the prickly pear.

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Parasitic plants. Several plant parasites such as broomrape, *Orobanche,* occur on weedy species, but too often are capable of attacking the crop also.

Insects. Many insects do much damage to weedy plants as well as to cultivated plants by working on their roots, stems, leaves, flowering parts or seeds.

Rodents are very fond of certain weeds but too often prefer more valuable plants or at least damage the cultivated plants in the quest for their favorite weed.

Birds consume enormous quantities of weed seeds, and deserve to be protected. Among the seed eating species occurring in California are the mourning dove, the red-winged blackbird, the western meadowlark, the tree sparrow, the linnet, the horned lark, the chipping sparrow, the snowbird, the white-crowned sparrow, the Audubon warbler and the quail. The following statement on birds as weed destroyers is quoted from Sylvester D. Judd:[1]

"No less than fifty different birds act as weed destroyers and the noxious plants which they help to eradicate number more than three score species. Some of these plants are much more in favor than others, while several are almost universally sought after. During the colder half of the year food is furnished for many species of birds by well-known and widely distributed weeds.

"The blackbirds, the bobolink, the dove and the English sparrow, in spite of grain-eating proclivities, do much good by consuming large quantities of weed seed.

"Shore larks and grosbeaks also render considerable service, while the meadowlark is even more beneficial. Goldfinches destroy weeds which are not touched by other birds, confining their attacks chiefly to one group of plants (the Compositae), many of the members of which are serious pests.

"But the birds which accomplish most as weed destroyers are the score or more of native sparrows that flock to the weed patches in early autumn and remain until late spring. During cold weather they require an abundance of food to keep their bodies warm, and it is their habit to keep their stomachs and gullets heaping full. Often one of these birds is found to have eaten 300 seeds of pigeon grass or 500 seeds of lamb's-quarters or pigweed. Because of their gregarious and terrestrial habits, they are efficient consumers of seeds of ragweed, pigeon-grass, crab grass, bindweed, purslane, smartweed and pigweed. In short, these birds are little weeders whose work is seldom noted but always felt."

[1]Sylvester D. Judd, Yearbook U. S. Dept. of Agri., 1898.

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Thistles.

The word thistle has been more generally misused than any other word in the botanical dictionary. It is applied to annuals and perennials, to tumbleweeds and to spikeweeds. In fact, almost every plant which has sharp spines or bristles has at one time or another been called a thistle. The so-called Russian thistle is not a thistle at all but one of the pigweed and tumbleweed tribe. It was first called by the Russians "wind-witch" and later given the name it now carries on account of its spiny character. Some of the ragweed tribe are called thistles, such as *Xanthium spinosum*—spiny clot-bur or Spanish needles. Others class the spikeweeds, prickly lettuce, blue weed, nettles, dandelion and many other plants with the true thistles. All of the true thistles belong to the Sunflower family, bear composite flowers and the seeds carry pappus hairs or plumes attached to the upper end. The leaves of thistles are prickly and very hard to handle by hand. They are avoided by stock and often absolutely ruin pasture land on this account.

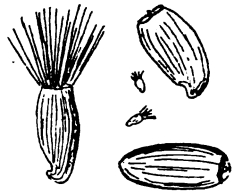

FIG. 123. Yellow-star thistle (*Centaurea solstitialis*): Showing thistledown character of seed.

Due to the character of thistle seeds the wind scatters them far and wide and any method of control which is undertaken should include as the most important feature prevention of seed production. Individual species require special treatment and it is not always possible to kill them by mowing.

By reference to the index under the heading "thistle" will be found a list of all the plants mentioned in this book which are or have ever been called by that name. Methods of control of some of the most important species will be found in other parts of the book.

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HERBICIDES.

By GEO. P. GRAY, Sacramento, California.

CHEMICALS IN WEED CONTROL.

Chemicals have been used for the control of weeds in at least two ways in which the manner of entrance of the poison into the plant is fundamentally different. A well-defined conception of this difference is essential to the intelligent formulation of control measures. One or the other may be the more suitable procedure to adopt, depending on various conditions.

Poisons Absorbed Through Roots of Plants.

A chemical may be applied by various means in sufficient quantity to permeate the soil to a considerable depth. The poison is then absorbed into the plant through its root system and disturbs its vital functions. The aerial parts may incidentally be destroyed by local absorption, but main reliance is placed upon the production of a toxic condition in the soil in which the plant is growing. It may be said that the food of the plants is poisoned. This toxic condition may be only transitory or may endure for a great length of time, depending upon many factors, such as volatility and solubility of the chemical, its affinity for the soil elements, the quality of the soil, drainage conditions, etc. For the purposes of discussion, this method of applying chemicals for the control of weeds will be referred to as the *"root absorption method."*

Poisons Absorbed Through Leaves of Plants.

A chemical may be applied to the aerial parts of the plant only, by means of a spray or otherwise, dependence in this case being placed in the absorption of the poison by the aerial parts in sufficient quantity to cause the death of the plant or failure to mature seeds. The poison falling upon the soil is merely incidental to spraying the foliage and is kept to a minimum. This method will be referred to as the *"leaf absorption method."*

Comparison of the Two Methods.

By way of analogy to the customary classification of insecticides, one may think of herbicides applied by the root-absorption method as corresponding to stomach poisons and those applied by the leaf-absorption method as corresponding to the tracheal poisons. In the first case it is the food of insects and plants which is poisoned; in the second case, the leaves of a plant are its breathing apparatus and have been called the "lungs" of plants, so there is a striking similarity in the *modus operandi* of poisons absorbed through the leaves of weeds and those absorbed through the tracheae of insects.

The root absorption method of necessity involves the use of a large amount of poison—enough not only to stop the functioning of the plant, but also to produce *a toxic condition in all the soil in the vicinity of the root system.* The necessary quantity to produce this condition

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may be materially increased by a large part of the poison being rendered inert by chemical or physical changes brought about by contact with the soil. In addition to the cost of the chemical there is frequently a high cost of application.

On the other hand, the leaf absorption method requires the use of the minimum amount of poison—just enough to stop the functioning of the plant; *it does not involve the poisoning of the soil.* Even though a very poisonous substance is used it is so evenly distributed over the area treated that the possibility of injury to the soil is reduced to the minimum. In this method, the poison usually is sprayed upon the foliage of the weeds, which is probably the most economical manner of application. A saving in cost of both materials and application is therefore apparent.

The first method appears to be suitable for the application of a nonvolatile herbicide where the sterilization of the soil is desired; that is, on nonagricultural land, but naturally the amount of poison required will be very large. A volatile herbicide, such as carbon bisulfide, is effective when used in this manner, but both the expense of application and the cost of material is high. In all cases that have come to the attention of the writer, where chemicals have been used by this method, the cost would prohibit its use, except on small areas, as a *control* measure; if practical *eradication* has not been accomplished, the results have not justified the means.

The second method appears to be the more adaptable as a control measure for weeds on agricultural land for reasons which are at once apparent. The cost of both materials and application is comparatively low and the amount of poison contaminating the soil is reduced to a minimum.

PRESENT STATUS OF HERBICIDES IN AGRICULTURAL PRACTICE.

Substances which have been most frequently recommended as herbicides are: Arsenic, copper sulfate, iron sulfate, salt, petroleum oils, coal-tar oils, sulfuric acid and carbon bisulfide. Pintsch-gas refuse is reported to be particularly effective against Johnson grass and salt grass but only a limited supply is available. A soluble compound of arsenic is probably the most effective and the cheapest of the plant poisons which have been given an extensive trial. It has been successfully used as an herbicide against a great variety of weeds and under a wide range of conditions.

The earlier experiments of Professor H. L. Bolley[1] looking toward the control of weeds in grain fields by means of chemical sprays attracted world-wide interest. Quoting from this author, "The preliminary trials in 1896, were, perhaps, the first experiments of the kind conducted in any country." These and later experiments by the same investigator[2] have amply demonstrated that iron sulfate and copper sulfate are effective agents for the control of mustard and certain other weeds in the grain fields of the middle west. Bolley's conclusions have been confirmed by a number of other workers, so that

[1]Tenth and 11th Reports. 1901. N. Dakota Agr. Exp. Sta.
[2]Bolley, H. L. 1903–1909. Press Bulletins 9, 25, 26, 27, 28, 29, and Bull. 80, N. Dakota Agr. Exp. Sta.

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many of the experiment stations recommend the use of chemicals, particularly iron sulfate, for the control of weeds in grain fields and for other purposes. The use of herbicides, however, has not become a common practice in the middle west as was shown by the replies to inquiries received from the Directors of the Agricultural Experiment Stations of Nebraska, Indiana (Purdue), Michigan, North Dakota, Kansas, Wisconsin, Minnesota, Ohio and Illinois.

Sodium arsenite has been used a number of years as a matter of common practice for the destruction of weeds on the rubber, sugar and pineapple plantations in certain sections of Hawaii. Quoting from a recent publication by McGeorge[1]: "At the present time this means of controlling weed growth has long since passed the experimental stage and is now quite widely applied. Especially is it applicable in the rainy sections where the growth of weeds is profuse and cultivation is often impossible without puddling the soil."

Pipal's experiments in Indiana[2] and Selby and Van Atta's experiments in Ohio[3] have shown that wild garlic and wild onion can be economically controlled by spraying with petroleum distillates such as "orchard heating oil," "fuel oil" and "Richmond smudge oil."

The Queensland Department of Public Lands, confronted by a very alarming situation in the spread of prickly-pear (cactus), sent a commission around the world to study weed control methods and maintained an experiment station at Dulacca for several years for the purpose of determining the best means of eradicating the introduced pest. It is stated in the final report of Dr. White-Haney[4], the officer-in-charge, that two species of *cochineal insects* introduced into Queensland by the traveling commission show promise of completely clearing off the *Opuntia monacantha* pear from the state.

In regard to control by means of chemicals it is stated in the same report that: "The most effective pear-destroying specific yet known—viz., arsenic acid—has also been determined. The work, however, has only really just commenced and the problem of pear destruction is a most pressing one regarded from the point of view of the pastoral industry of Australia.

"In the badly pear-infested pastoral land the cost of poisoning, even if reduced to the cheapest of specifics and to the minimum amount of labor necessary, is too excessive to render such action possible. In most cases the expense involved by this method of clearing would exceed the present value of grazing land. The only real solution of the difficulty appears to lie in the possibility of the discovery of some parasitic insects or organisms capable of bringing about the destruction of the different species of prickly-pear as completely as the *Coccus indicus* (Green) has done for the monacantha species in North Queensland.

[1]McGeorge, W. T. 1915. The Effect of Arsenite of Soda on the Soil. Hawaii Agr. Exp. Sta., Press Bull. 50.

[2]Pipal, F. J. 1914. Wild Garlic and its Eradication. Bull. 176, Purdue Agr. Exp. Sta.

[3]Selby, A. D., and Van Atta, D. R. 1916. Kill Garlic and Wild Onion by Oil Spraying. Vol. 1, No. 12, Mo. Bull. Ohio. Agr. Exp. Sta.

[4]White (White-Haney), Jean. 1914-1916. Reports of Officer in Charge of the Prickly Pear Experimental Station, Dulacca. Reprints from Reports of Queensland Dept. of Public Lands, appendix 4 of the years 1912, 1913, 1914, 1915. In the report for 1915–1916.

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"It is the possible discovery of some such parasite which urgently needs investigation now.

"Meanwhile the use of poisonous specifics, especially arsenic acid when obtainable, should afford relief to agriculturists and selectors whose land, unfortunately, possesses the pear as an unwelcome tenant. The need for further investigations is imperative on account of the rapidity with which the pest is spreading." (7-p. 41.)

The writer[1] has recommended an arsenical spray for the control of wild morning-glory in California. The proposed method is effective within the fog belt only and is of restricted application.

In the development of this method it was shown that arsenic is a very effective and cheap soil sterilizer in respect to most weeds, and is useful for this purpose on graveled walks, fencerows, and roadways.[2] Soil to which one ounce or more of arsenic per square yard had been applied remained barren of all vegetation, except wild morning-glory, for 14 months notwithstanding the leaching by the rains of two winters.[3]

These experiments have furnished a basis for further experiments on the problem of weed control on railroad rights of way. This matter has already received considerable attention by a number of railroads, some of which have used many tons of arsenic on their roadbeds but the danger of poisoning live stock has had a restraining influence on its use. An attractive line of investigation would be the search for some repellant to be added to a poisonous herbicide to make it unattractive to live stock.

"The water hyacinth is so abundant in Florida, Louisiana and Texas as to obstruct navigation in the waters emptying into the Gulf of Mexico. Its eradication was entrusted in 1899 to the United States Engineer's Office of the War Department, to which was given authority to remove the plant by any chemical, mechanical, or other means whatever. From that time the Engineer's Office has worked continuously on eradication and has spent hundreds of thousands of dollars in attempting to remove it from navigable streams. No method has ever been found which will completely remove the plant at a reasonable cost, although every known chemical has been experimented with; but the solution which has been found most effective is an arsenical spray."

The above is quoted from Johnson[4] who also states that 1,613,383 square yards of hyacinth were sprayed in Louisiana waters during the year ending June 30, 1919, at a cost of $13,464.21 or $0.0093 per square yard.

"In spite of the enormous quantities of this pest destroyed annually since the work was first undertaken in 1899, it is still necessary to repeat the control measures year after year. So insidious is this floating menace to navigation that wherever the strictest precautions are not observed, a stream or harbor may be overnight rendered impassable."

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[1]Gray, G. P. 1917. Spraying for the Control of Wild Morning-glory Within the Fog Belt. Calif. Agr. Exp. Sta., Cir. 168.

[2]Gray, G. P. 1919. Weed Control Along Fencerows and Roadways. *In* Mo. Bull. Dept. Agr. of Cal. Vol. VIII, No. 10, pp. 599-603.

[3]Gray, G. P. 1919. Tests of Chemical Means for the Control of Weeds. A Report of Progress. *In* Univ. California Pub.; Agr. Sci. Vol. 4, No. 2.

[4]Johnson, E. 1920. Water Hyacinth. A Menace to Navigation in the South. *In* Mo. Bull. Dept. of Agr., State of California. Vol. IX, No. 3, p. 77.

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COMMERCIAL WEED KILLERS.

There are numerous compounds on the market widely advertised for the destruction of various weeds. Many of these have been analyzed in the writer's laboratory, and with one exception the active ingredient has been found to be arsenic. The one exception is essentially carbon bisulfide sold under the name of "Nonpareil." All of them have merit, but the extravagant and often ridiculous claims made for most of them have placed the more conservative advertisers in bad repute.

The most serious aspect of the matter is that these highly poisonous compounds of arsenic are placed in the hands of the purchaser, generally without warning as to the nature of the contents. Some manufacturers even go so far as to insist that their preparation is absolutely nonpoisonous to the soil. But if a cupful of the weakest of these arsenical preparations examined were evenly distributed over a square yard of soil (or four tablespoonfuls of the strongest one), no crops could grow in that place for many months and perhaps years. There is a limited field of usefulness for such preparations in weed control and soil sterilization, but they can not be intelligently used without a knowledge of their composition.

As may be inferred from the above, the commercial herbicides are of extremely variable composition and their composition as a rule is surrounded with an air of mystery. The exorbitant prices so often charged for these solutions can only be accounted for as an attempt to obtain "royalties" on alleged "wonderful discoveries" in weed-control methods. One brand frequently called to the attention of the writer commonly sells for $2.50 per gallon, but the essential ingredients can be purchased for a few cents. The recently enacted economic poison law will doubtless be somewhat discouraging to the professional faker. The common interests of both seller and buyer will be safeguarded by this law.

The writer has always recommended the home preparation of arsenical herbicides because of the great variability of commercial preparations. This is not a difficult nor dangerous undertaking if it can be done out of doors and the operator is at all familiar with the handling of chemicals. The saving in expense is considerable if a large quantity is to be made. The bringing of poisons into the house for preparation on the kitchen stove is a practice to be avoided if possible, but at present it seems to be about the only way of securing a solution of definite strength for experimental use.

On the other hand, if manufacturers would make up a standardized, concentrated solution of arsenical containing any convenient amount of poison (say 4 bbls. of arsenic trioxide per gallon), and would truthfully state the contents on the label, the writer would unhesitatingly recommend its use in perference to the home preparation, especially of small amounts.

THE LEGITIMATE USE OF HERBICIDES.

The writer has no hope nor desire that chemical means will eventually supplant old established cultural means for the control of weeds. It seems evident that cultural means are to be preferred whenever adequate. The legitimate use of chemicals in this connection appears

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to be in such cases where cultural or mechanical means usually fail, are unduly expensive, impossible, or undesirable for various reasons, specific examples of which have been given above.

Thus restricting the legitimate use of herbicides, there are still many important problems the solution of which may be simplified by the intelligent use of chemicals. Stated in a general way, some of these problems are:

1. The control *on agricultural land,* without injury to the soil, of weeds which are very difficult to control at reasonable expense by the known cultural methods.

2. The control *on non-agricultural land,* or *on uncultivated land,* of miscellaneous weeds which are a constant source of infestation to cultivated land, and which at present are either controlled at great expense by hand labor on account of the difficulty or impossibility of cultivation, or are left uncontrolled because of the expense involved without direct financial return. Some specific problems of this sort are:

(a) The control of miscellaneous weeds along fences, roads, canal banks, ditches, etc., and on wasteland.
(b) The control of miscellaneous weeds along state highways.
(c) The control of miscellaneous weeds along railroad rights of way.

3. The clearance of land from brush, cacti, etc.

4. The control of poisonous plants.

5. The control of certain weeds which seriously interfere with navigation or with the maintenance and operation of irrigation systems, but which are not necessarily detrimental in other ways.

CONCLUSION.

While the references cited above, and others, indicate that practical application of chemicals can be and has been made in weed control, the results have been accomplished largely by "cut and try" methods. The experiments have not been based on any comprehensive knowledge of the life history, habits and structure of weeds, both above and below ground, nor of the nature of the effect of chemicals upon them.

The writer's investigation on the control of weeds by means of chemicals, while a member of the staff of the California Agricultural Experiment Station, was discontinued during the war after two years' intensive study. As the work progressed, the importance and complexity of the original problem became more and more evident and new problems of plant physiology were brought to light, so that the time and thought of the writer finally became almost entirely absorbed in the work to the detriment of his teaching, investigations, and routine work in connection with the insecticide and fungicide laboratory. A full day's hard labor was frequently required in order to make a satisfactory examination of the results of a single treatment, much of which could have been done by a careful assistant.

Experimentation was not resumed because it seemed illogical to continue without the cooperation of a plant physiologist who could simultaneously attack the problem from the standpoint of the botanist,

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and no funds were available, even for continuation along the lines of the previous work. In the writer's new connection there is no immediate prospect of being able to take up fundamental investigation of the weed problem.

This study has not by any means been barren of results, however. It has shown, in respect to the wild morning-glory, that apparently the action of chemicals upon this weed is profoundly influenced by the stage of maturity of the plant, and, in the case of arsenical sprays, also by the amount of atmospheric moisture at the time of treatment. White-Haney's conclusions in respect to the effect of chemicals on cacti are of a similar nature.

These two independent investigations pointing toward the same conclusions have at least opened up a new line of thought in weed control by means of chemicals and pointed the way toward future investigations. They have shown that a comprehensive knowledge of the anatomy, physiology and ecology of noxious weeds is fundamental to the intelligent formulation of both chemical and cultural methods of control. The life cycle and habits of growth of the aerial parts of the commoner weeds are fairly well known, but a knowledge of the underground parts of the deep-rooted weeds is very meagre. Rapid progress will not be made in the improvement of present control methods, nor in the development of new methods, until more fundamental information of the character indicated above is supplied.

Modern fumigation and spray practice for the control of insects and fungi is founded upon exhaustive research, to the minutest detail, of the life histories and habits of insects and fungi. It is the writer's full conviction that if future progress is to be made in the use of herbicides, the problem must be attacked in the same manner. A comprehensive study of weeds from the botanical standpoint should precede or accompany the study of the effect of chemicals upon them, and to accomplish the best results the two should be closely correlated.

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WEED CONTROL METHODS IN SPECIAL LOCATIONS.

By ETHELBERT JOHNSON, Sacramento, California.

The prevalence of specialized farming in California in many cases makes rotation of crops impracticable. In such instances, the matter of weed control is largely a question to be worked out for the individual case. It may be worth while, however, to mention a few of the possible means of control in certain crops.

ORCHARDS AND VINEYARDS.

The most troublesome weeds in orchards are those which are so strong-growing as to interfere with tillage operations or those which reproduce rapidly or in great abundance.

(1) Where orchards are clean cultivated, or where a hoed intercrop is grown, the matter of weed control is comparatively easy. Frequent cultivation makes it possible to kill the weeds at their most vulnerable stage, which is just after sprouting. The longer a weed is left, the harder it is to kill and the more damage it does in robbing the soil of moisture. Perennial weeds, like wild morning-glory, are more readily controlled if not allowed to form green leaves. The roots depend on the leaves for their food supply, and if no leaves are allowed to form, the roots will be starved out.

(2) Where a cover crop is grown to be turned under, it is not so important to prevent the seeding of a few comparatively harmless weeds; but noxious weeds should be guarded against and killed before going to seed. If there is a large infestation of a perennial weed, it will be better to omit the cover crop and practice clean cultivation until the weed is under control.

(3) Where the growth of weeds is depended upon for the cover crop it is desirable that they should seed themselves, unless a noxious weed should gain entrance to the soil. If the noxious weed is an annual, like the Russian thistle, it is necessary only to turn under the cover crop before the weed goes to seed. If it is a perennial, like morning-glory, it is better to change the system and practice clean cultivation until the weed is under control.

(4) Under special conditions, where soil or moisture make it desirable to allow the weeds to grow, the presence of noxious weeds should be checked by hand work, if this is possible.

INTERTILLED CROPS.

If properly handled intertilled crops are the best means of ridding a field of weeds; but if cultivation is indifferently practiced the intertilled crop is merely a breeding ground for weeds.

The success of weed control in a cultivated crop depends largely upon the preparation for planting. For such crops as corn, beans, and sugar beets, it is well to plow the field in the fall in order to force the germination of weed seeds as well as to leave the ground in shape to catch the greatest amount of the winter precipitation. The ground is then worked down into a seed bed in the spring, either with or without a shallow plowing to kill the weeds which have sprouted. In late

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planted crops, like beans, it may be necessary to disk or cultivate the ground several times before planting in order to control the weeds and to conserve moisture.

Immediately after planting the crop, it is advisable to go over the field with a light spike-tooth harrow with the teeth turned back slightly. This will kill many sprouted weed seeds and will stir up the soil pressed down by the planter wheels which otherwise would form a good seed bed for many weeds. This light harrowing may be repeated to advantage just after the crop comes up. When the crop becomes so large that it would be injured by harrowing, cultivation should begin. It is not well to wait until the weeds begin to cover the soil, for they are much more easily killed when they have just begun to sprout. In crops that are check-rowed and cross cultivated, the cost of weed control will be greatly reduced since the number of weeds to be cut out by handwork is decreased. From the standpoint of weed control, the most efficient type of cultivator is the sweep or V-shaped weed knife, since it cuts off the weeds just below the surface of the ground and is less likely to slip around a tough stem or root than the ordinary shovel-tooth cultivator.

In nearly all cultivated crops a certain amount of hoeing is necessary. The expense of hoeing is one of the largest items in the cost of producing the crop. The more efficiently cultivation is performed, the less hoeing will have to be done.

The last cultivation should be timed as late in the season as the size of the crop will permit the implement to go through the field without injuring the plants. The last cultivation is very important in weed control since whatever weeds are left will mature their seeds and infest the land for the succeeding year. In addition, if many weeds are left to grow, the harvesting of the crop will be seriously interfered with.

After the crop is removed, the weeds ought not to be neglected. If it is not desirable to plow or disk the land immediately, the seeding of many weeds can be prevented with comparatively little expense by a close mowing. It is still better and more profitable to allow sheep to graze off the weeds but this should not be postponed or continued until the plants go to seed.

GRAIN FIELDS.

The weeds most troublesome in grain fields are those which mature their seeds before the crop is mature and so reseed the land; those which mature their seeds at the same time and become an impurity in the grain, especially those which are difficult to separate or whose presence in the grain results in a reduction of the market value; those which drag down the crop; those which interfere with the operation of harvesting machinery; and those which are green and succulent at the time of harvesting, interfering with proper drying, or causing heating in the sack or shock.

Where systematic rotation is practiced, a grain crop can usually be worked in without creating any special weed problem, provided care is taken to sow clean seed.

Grain land in which rotation of crops can not profitably be practiced can be kept comparatively free from weeds by proper cultural methods.

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If the land is plowed early in the fall, the early rains will start many of the weed seeds which can be killed with the disk just before sowing the grain. A light harrow with the teeth set back can be used immediately after sowing in the fall and again in the spring to kill many weed seedlings without permanent injury to the crop.

The use of a selective herbicide, such as iron sulphate or copper sulphate, has met with success in some states in destroying broad-leaved plants, such as mustard and radish, in grain fields. Iron

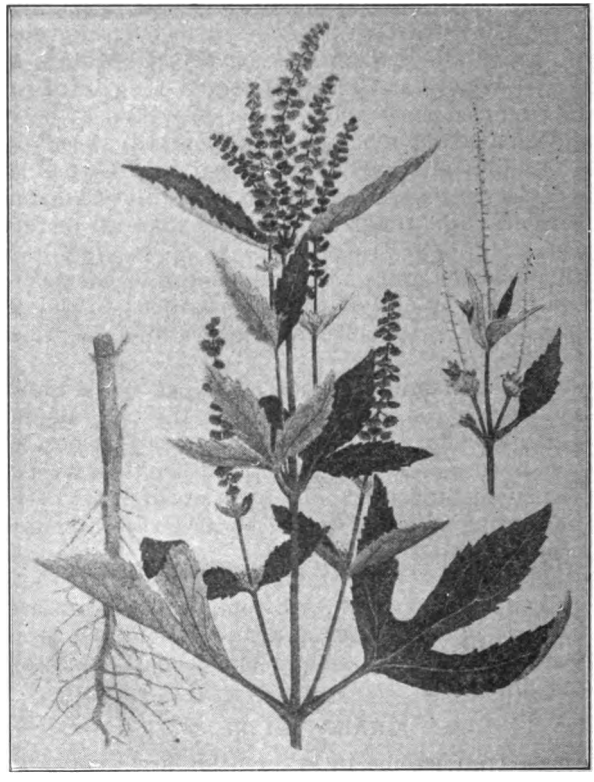

FIG. 124. Greater Ragweed (*Ambrosia trifida*), one of the plants which induces hay fever. Our species, *Ambrosia psilostachya*, is commonly found in uncultivated lands and along fence rows.

sulphate has been successfully applied at the rate of 100 pounds dissolved in 50 gallons of water, preferably when the grain is in the rosette stage, since the injury to the grain is least at this stage while the majority of the weeds have germinated and are usually higher than the grain. The best results have been obtained when the spraying is done in the early morning or on a dark, damp day.

The use of the binder in weedy fields by removing the crop a few weeks earlier makes possible a very great saving in combating weeds and has, besides, the advantage of curing the grain more uniformly and

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of saving an appreciable amount of grain from scattering. The combined harvester is an enemy to clean grain fields in California. Where it is used, the harvest is often postponed until many weeds have seeded which would have been cut off before seeding had a binder been used; the summer weeds have often reached a size which materially increases the cost of harvesting; their green leaves interfere with the drying of the grain, often heating or discoloring it; and all the weed seeds which are separated from the grain are returned to the land to reseed it for the following season.

After the crop is off, care should be taken not to allow the weeds to go to seed. A flock of sheep will profitably take care of this operation. If sheep are not available, it is better to disk or plow at once than to allow the weeds to seed; or if this is not practicable, to go over the field with a mower.

The problem of weed control is extremely difficult under the conditions of extensive farming and continuous cropping which obtain so generally in the grain sections of California. When land becomes so foul with weeds that continuous cropping to grain is no longer profitable, it may be partially cleaned by fallowing every second or third year. The practice of fallowing is followed in many sections where the principal object is the conservation of moisture, and if properly performed is valuable in clearing the land of the weeds which make such heavy demands upon the limited moisture supply. The weeds should be encouraged to sprout by fall plowing and should be kept from developing by spring disking or cultivating. When the ground has thus been cleared of weeds it should not again be fouled by the sowing of impure seed.

WEED CONTROL IN ALFALFA FIELD.

Alfalfa is a very useful crop in the rotation, for besides its well-known ability to improve the soil and to furnish a large tonnage of valuable forage, its dense growth will shade out many weeds, and its frequent cutting will prevent the seeding of many others. Some weeds, however, such as foxtail, *Hordeum*, will not be killed out, and may, as the stand of alfalfa becomes less dense, choke out the crop. If the alfalfa field is to be kept free from weeds, it is of the utmost importance to sow only pure seed. The worst enemies of alfalfa, the dodders (*Cuscuta* spp.), are practically always introduced in the seed.

The preparation of the seed-bed is important. It should be treated in such a way as to cause the weed seeds to sprout so that they can be easily killed. Weed seeds are often introduced in the irrigation water.

When a field of alfalfa is badly infested with weeds like foxtail, the first cutting may be so weedy that its value as hay would be greatly reduced. In this case, the first cutting may be profitably used as ensilage. Most weed seeds are killed in the process of fermentation and the product forms a nutritious food for cattle. If beards of foxtail, or broncho grass, are present in large amount, it is important not to allow the silage to dry in the feed boxes, for the dried beards are quite as capable of inflicting injury to the mouths of cattle as though they had not passed through the ensiling process.

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The use of the alfalfa renovator, or spike-tooth disk, is of value in controlling weeds as well as in forming a mulch and increasing the vigor of the crop by splitting the crowns. The spring-tooth harrow is also satisfactory for this purpose.

When a selective spray, like iron sulphate or copper sulphate, is used, as has been the case in alfalfa fields, the alfalfa is very apt to be blackened but new shoots are sent up from the crown, and the injury is not permanent. It has been more or less successful in combating dodder and a number of broad-leaved annuals.

When an alfalfa field is badly overrun with weeds, it is better to plow it under than to try to get along with decreased yields and reduced value. If an intertilled crop can be run in before reseeding, it will be of great value in minimizing the weed problem.

LAWNS.

A lawn can be kept from becoming weedy much more easily than it can be freed from weeds which have gained a foothold. The soil should be well prepared, in good physical condition and finely pulverized. The addition of manure will improve the richness and physical condition of the soil, but the manure should be well rotted so as to be free from weed seeds. If well rotted manure can not be obtained, it is better to depend on a cover crop or some other fertilizer than to sow the lawn with weeds by applying manure which has not been composted. When the soil is prepared for the seed, it is better to water it thoroughly before seeding in order to sprout the weed seeds which can be killed by raking over the soil.

Having taken precautions to have the soil fairly free from weeds, it is of the greatest importance to sow only high grade seed, free from weeds and of good vitality. Seed samples are tested free of charge for impurities and for viability by the Laboratory of the Department of Agriculture. The lawn should be seeded thickly so as to establish a good sod and make it difficult for weeds to become established. Every year or two, in order to maintain a good stand, the lawn should be broadcasted with high grade seed free from weed seeds.

Plenty of water, regular mowing and an occasional application of fertilizer or well-rotted manure, should keep the lawn in fairly good condition.

The most practicable method of destroying weeds in a lawn is by hand work. To eradicate some weeds care must be taken to get all of the root. Cutting off a little below the surface of the ground only helps to spread such pests as dandelion and plantain, for buds will sprout from the crown and make a dozen plants where there was but one before.

Experiments with iron sulphate sprays in some states indicate that this method may be useful in controlling dandelion, mouse-ear chickweed, and other weeds without permanently injuring the lawn. Other chemicals, such as sodium arsenite or carbon bisulphide, may be applied to individual plants by means of an oil can or homemade dropper.

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GARDENS.

Garden seed is fortunately usually free from weed seed, and the problem of weed control in gardens, because of the relatively small size and the need of frequent cultivation, is not difficult. The weeds most frequently met with in gardens are annuals, which are easily killed with the hoe. If a creeping perennial like morning-glory should become established, the patch may be grubbed out or covered over with roofing paper or straw to exclude the light or the weed may be controlled by hoeing every few days to prevent the growth of leaves.

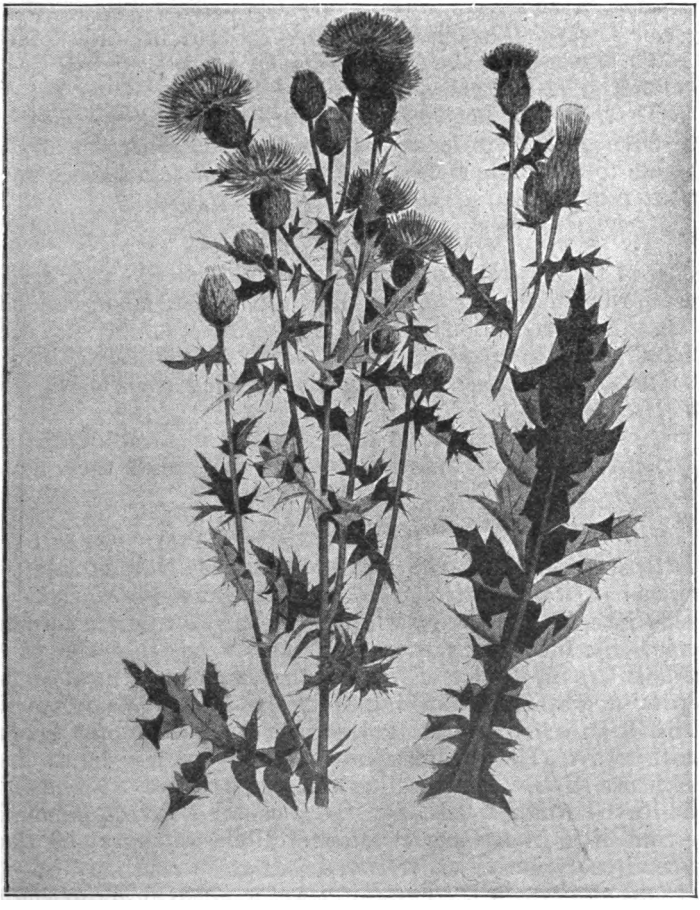

FIG. 125. Bull thistle (*Cirsium arvense*), growing along roadsides is a constant source of trouble in the neighboring fields.

WALKS, COURTS, ETC.

Wherever it is desirable to sterilize the soil permanently, the simplest method of control is by means of a chemical herbicide. Persistent perennials like morning-glory which are not killed by the process, may be gone over with the arsenical or with carbon bisulphide whenever

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they appear. The herbicide may be applied with an ordinary oil can or with a homemade dropper.

WASTE PLACES.

Roadsides, fence-lines and land allowed to run waste form the most favorable breeding ground for weeds, and the insect and fungous pests which use the weeds as a host make waste lands one of the most serious menaces to agriculture. Sterilization of the soil is an effective means of eliminating weeds in such places; although in many instances this is scarcely practical because of the high cost and the danger in handling the materials.

It is not always desirable to sterilize the soil in waste places. In many cases mowing the weeds before they go to seed will keep them from spreading or if this is not feasible, cutting down the noxious weeds with a scythe, hoe or spud will hold them in check. Many farmers burn over their fence rows annually. Wherever practical it is advisable to eliminate fences and thus eliminate a harbor for weeds and insect pests.

GREENHOUSES.

Because of the careful attention which plants receive in a greenhouse, the weed problem should not be difficult. Much labor can be saved by taking a few precautions to prevent the introduction of weed seeds. Imperfectly composted manure is probably the most frequent avenue of introduction. Another source is the packing used about trees and shrubs.

Where weed seeds are known to be present in large quantities, it is well to start the weeds by watering the beds and killing them by stirring the soil.

WATERWAYS.

In ditches and streams and on ditchbanks, as well as in rice fields, the problem of weed control is sometimes very serious. Not only do the weeds interfere seriously with the flow of water, but their seeds are carried onto the land in irrigating. It is rarely desirable to sterilize the ditchbank, as a binder of vegetation is necessary in most types of soil to prevent washing and filling up of the ditch. Where sterilization by means of an arsenical solution is attempted care must be taken to keep stock away. The sterilizer can be applied when the ditch is dry, and will serve effectively in killing the weeds and weed seeds.

Broad-leaved water weeds, like the pickerel weed (*Pontederia* sp.), may be controlled in streams, canals and ditches by spraying the leaves with a dilute solution of an arsenical.

The usual practice in keeping down water weeds in irrigation ditches is to go over them frequently with brush hooks and potato forks and remove those which obstruct the flow. The use of the mower along ditchbanks is effective in keeping weeds under control. The cut weeds may be left or may be burned. Sheep may also be used to keep down weeds but in loose soils are likely to cause the ditch banks to break down.

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Where the water is known to carry large quantities of weed seeds, like water grass, *Echinochloa,* it is advisable to place screens in the headgates. This practice requires a considerable amount of work to keep the screens clean but it is better than allowing the land to become infested.

RICE FIELDS.

Large areas of rice lands in the Sacramento Valley have been rendered unprofitable through the presence of water weeds, such as water-grass (*Echinochloa crus-galli*) and cat-tails (*Typha* spp.). The means of control which most readily suggest themselves are adequate drainage which in a large section of the rice-growing area can be had only by artificial means; and rotation with a cultivated crop. Much of this land, however, is not adapted to the profitable production of crops other than rice, so that there may be nothing to do but to fallow an area so badly infested that it no longer produces profitable crops of rice.

WARNING TO RICE GROWERS.[1]

To Rice Growers and Owners of Rice Lands: Look out for water grass and other dangerous weed pests.

If your land is free of these, keep them out. If your land is slightly infested, eradicate at once. If your land is badly infested, take drastic measures with two purposes in view—first to prevent their spread, second to eradicate or control them.

Sow Clean Seeds. This is most important. Use clean water; screen it if necessary; pull the grass out of your fields; it is lighter green than rice. Use a spud and cut below the crown of the plants. If it is too thick to pull, grow cultivated crops and cultivate well.

If your land is foul, don't plant rice this year. You will get a light crop and a low price and your weed problem will be worse next year. Clean your land and clean it now. This will be most economical. Urge your neighbor to clean his at the same time.

Remember rice is a profitable crop; the most profitable that can be grown on much of the rice lands—and that it will continue profitable provided only these weeds are kept under control.

Water-grass seed in your rice means a lower price for your crop.

Water-grass seed on your land means no rice in the near future.

Don't underestimate the importance of the rice weed problem. The profits of the industry depend upon its being solved and it must be solved right away.

Don't imagine you can kill these weeds by growing barley. You can't. To kill them after they are well set is a big job and will cost money.

Don't be afraid to spend money when they first appear. This is the time to kill them, the time when eradication is easiest and cheapest.

Land owners leasing lands for rice culture should require lessees to keep fields, borders, and ditches clear of these weeds. Put it in the

[1]Quoted by Newman, Monthly Bulletin, California State Commission of Horticulture. Volume 5, No. 2, February, 1916, pp. 55-56, from Chambliss Bulletin No. 1, Rice Committee, Sacramento Valley Development Association.

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lease and enforce it. Reserve the right to do it at the expense of lessee—then do it at the right time if he does not.

Ditch companies should keep their ditches absolutely free of these weed pests. County roads must be kept clean. These things can all be done. They will pay. They must be done!

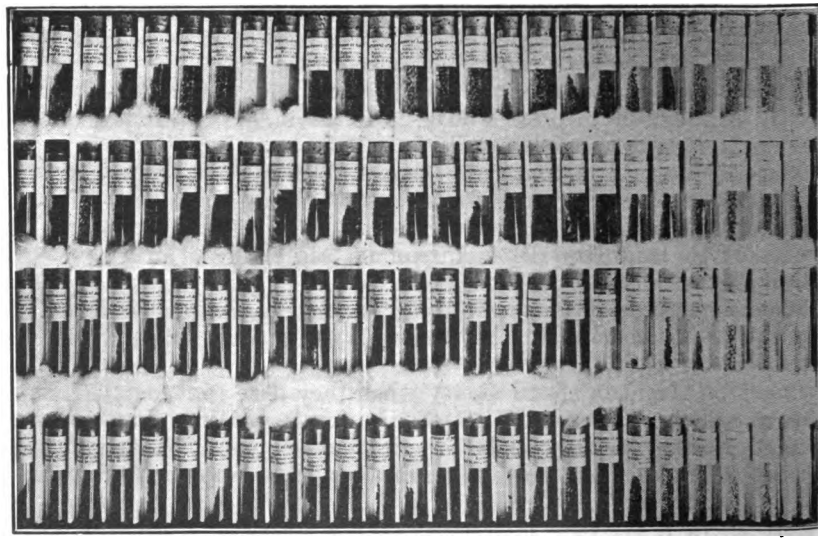
RANGES AND PASTURES.

The principal means of keeping down weedy plants in permanent pastures is to encourage the growth of desirable plants. Occasional seeding is desirable to maintain a stand of the forage plants strong enough to resist the encroachment of weeds. Care must be taken to sow clean seed. Scattering seed of a properly inoculated leguminous crop, such as sweet clover, *Melilotus,* will help to enrich the land, stimulate the growth of desirable plants and improve the forage. Top-dressings of commercial fertilizers, lime and gypsum have proved profitable in numerous instances by correcting some undesirable soil condition.

When a good range of desirable forage plants is established, it should not be weakened by overstocking. If the practice is followed of getting the maximum from the land in one year without regard to the future state of the pasture, the stand of desirable plants is weakened and opportunity given for noxious weeds to gain a foothold.

If weeds distasteful to stock are present in large amount, they may sometimes be controlled by mowing before they go to seed.

Where noxious weeds occur singly or in isolated patches, especially weeds injurious or poisonous to stock, hand eradication either by cutting or grubbing or by applying an herbicide, may be the only practicable method of control.



How to preserve weed seeds (see page 239).

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CONTROL OF NOXIOUS WEEDS.

By ETHELBERT JOHNSON and O. W. NEWMAN, Sacramento, California.

MORNING GLORY.

(*Convolvulus arvensis*)

Practically all of the experimental work on weed control undertaken in California has been directed against morning-glory. It is a pest primarily of cultivated lands, for it is well liked by stock and con-

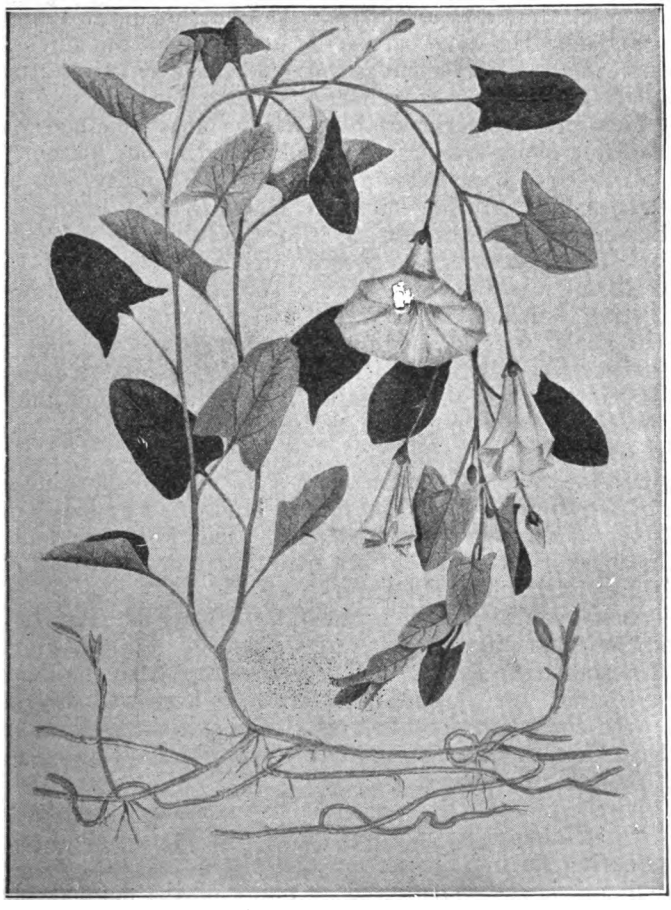

FIG. 126. The orchard or small-leaved morning-glory (*Convolvulus arvensis*), one of the most pernicious weed pests in California.

sidered an asset in pasture lands. Sheep in particular may aid materially in keeping it under control when in the leaf or flower stage and unringed hogs will eat a large proportion of the fleshy underground stems. Control methods in cultivated lands resolve themselves into two plans of attack: by cultural methods and by chemicals.

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The fleshy underground stems store up the plant food manufactured in the leaves and furnish nutriment to the vertical stems which are sent up to the surface of the ground. This drain on the stored-up food supply in the underground parts must be replenished by the food material which is manufactured by the leaves. If the plant can be prevented from forming green leaves, the underground part will in time become exhausted of its stored food material and die. Consequently, if the plant is kept continually cut off below the surface, it will in time be killed. If the plant is allowed to reach the light, the green leaves will form immediately and in a very short time will restore the vigor of the underground parts. The cutting must therefore be thorough, and must be done before the plants reach the surface. For this purpose, the best implement is the weed knife or sweep attachment to the cultivator. In the experiments reported in Circular 69, California Agricultural Experiment Station, the above method was used and the morning-glory was practically all killed in one season.

Mr. S. S. Rogers, a vegetable grower of Yolo County, has had considerable experience with the control of morning-glory in the vegetable fields. He succeeded in eradicating it by the following method:

"A crop of garden peas was grown during the winter of 1915 and harvested during the following May. The soil was dry-plowed to a depth of about 8 inches immediately after harvest and replowed at intervals of about 3 weeks during the summer until the first frost of fall. Between plowings the land was cultivated regularly once a week. A crop of cabbage was then planted and grown during the winter, and harvested the following June, after which the soil was treated as the preceding year.

"Although the field was practically a solid mass of morning-glory at the start of the work it was so completely eradicated by this two years' treatment that it has never appeared since. This work was done several years ago, therefore it is safe to presume that there will be no further trouble in this particular field again."

Three years ago the Trafton ranch, in Mud Flat, Pajaro Valley, undertook to clean up a dense infestation of morning-glory after taking off a grain crop in June. The grain crop dried the land pretty thoroughly, but it was plowed, clods crushed, harrowed several times, and then weed cutters were set to work. The cultivators were arranged to cut about three inches deep and run over the land every five days till frost came to stop growth.

Potatoes were planted the season following, and when the potatoes were cultivated almost no morning-glory was to be found, very few plants appearing during the season.

For small patches of morning-glory many of the methods discussed in the chapter on general weed control can be applied, such as smothering with manure or tar paper, planting of alfalfa or hand hoeing.

HERBICIDES.

Experiments with herbicides indicate that under certain conditions morning-glory can be controlled by a dilute solution of sodium arsenite. The most favorable conditions for its control appear to be a luxuriant

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growth of the plant and damp, cloudy or foggy weather. The treatment appears to be successful only in the coast climate.

CREEPING MALLOW.

(Sida hederacea)

This plant is quite as difficult as the wild morning-glory to control. It grows luxuriantly in rich, moist soils but is most troublesome in subsaline soils which are unfavorable to the best growth of the crop. Better drainage will often correct this condition. Creeping mallow will not endure deep shading for a long period of time but in those situations in which it is most troublesome, it is sometimes difficult to secure a sufficient growth of the commercial crop before it is overrun by the weed. Under irrigated conditions, a good stand of sorghum or Sudan can usually be obtained which will weaken the growth of the mallow by its shade. When the crop is removed, the land should be worked immediately in order to prevent the weeds regaining the advantage which has been obtained over them.

Creeping mallow is a very serious pest in sandy soils. Cotton fields in the southern counties have been considerably infested with this pest and the cost of production has been increased by the necessary extra cultivation entailed in its suppression. However, it can well be said that the extra cultivation is beneficial to the growth of the cotton.

The control problem is most acute when the cotton plants are young for it is dangerous to use horse cultivators closer than six or eight inches to the row and as a consequence considerable hand hoeing is necessary. When the cotton becomes large enough to shade the ground the growth of the creeping mallow becomes weak and spindling. In this condition it is easily controlled if the land can be plowed immediately after the crop is harvested.

In the bean fields of the southern coast counties, creeping mallow is becoming a troublesome pest. In such places the control measures must be similar to those recommended for field morning-glory. However, the use of chemicals has not yet been demonstrated as a satisfactory control measure for the woolly covering of the leaves prevents the spray from entering the leaf surface.

JOHNSON GRASS.

(Holcus halepensis)

Johnson grass is closely related to the cultivated sorghums and to Sudan grass, and as a hay crop is nearly equal to these in yield, quality, and palatability. As a pasture grass, it is somewhat less valuable, for close grazing and tramping seem to weaken the growth. Under certain conditions, stunted or second growth Johnson grass has been known to poison stock.

Johnson grass is propagated both by seed and by underground stems or rootstocks. The seed is produced in abundance, shatters readily, and has a hard covering which enables it to withstand adverse conditions. The rootstocks are large and fleshy, and under favorable conditions penetrate the soil to very great depth. The United States Department of Agriculture has made a study of the underground parts of this plant. The rootstocks are of three types: The first or primary roots are those alive in the ground at the beginning of the season;

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the secondary are those which arise from the primary when active growth begins, come to the surface, and form crowns which produce new plants; and the tertiary or storehouse roots which start downward from the crown of the new plant. The tertiary rootstocks start about flowering time, and especially if a large top growth has been formed, grow to large diameter and penetrate the soil to a great depth. The longer the top is allowed to stand after flowering, the larger and deeper will be the tertiary rootstocks. It is these roots which hold over winter and provide the starting point for the next year's infestation. The primary rootstocks expend their energy in forming secondary rootstocks and top growth and die off in the fall at the end of the growing season. The secondary and tertiary rootstocks left in the ground become primary rootstocks for the next season, and the cycle is repeated. It is important to understand the root growth of this plant to intelligently attack it.

On poorly cultivated land where the Johnson grass is allowed to grow after the crop is removed, a large tertiary growth is formed. On closely pastured land or wherever the grass is not allowed to develop much above ground, the underground development is likewise small. When an old sod remains unbroken for several years, there is practically no secondary growth and but little tertiary growth. These roots depend upon the top growth for their supply. When, therefore, the top growth is prevented the supply to the roots is cut off and their strength is gradually depleted.

From a knowledge of the rootstock or underground stem habits, a plan of attack against the weed can readily be formulated. In pastures or fields the grass should be allowed to form as dense a sod as possible for one or more seasons by grazing closely or by mowing, taking particular care to cut before blossoming every time a growth is thrown up. After the grass has been allowed to form sod for at least a year, it should be plowed shallow. If the plowing is done in the summer, a large proportion of the rootstocks will be killed by the heat of the sun and the dry atmosphere. The field should be watched for new growth, and the young plants killed before the seed is formed. If the plowing is done in spring, a cultivated crop may be grown, but it will require particular attention in order to remove all the young plants by the time they begin to head out.

Along ditch banks, fences, highways, railroad rights of way, and other situations where these cultural methods are impracticable, close cutting should be resorted to, or sheep or hogs may be turned in. Any method that will prevent seeding, especially along ditch banks, should be tried.

The use of chemical herbicides to control Johnson grass is considered impracticable, as no chemical has been found which will destroy it, and the use of herbicides simply to keep down top growth is costly as compared to cutting.

BERMUDA GRASS.

(*Cynodon dactylon*)

In the south, Bermuda grass is one of the most valuable of pasture and lawn grasses, because of its vigorous habit of growth in the heat

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of summer. Its rapid spread and the dense sod formed by the creeping stems make it exceedingly difficult to control in cultivated crops. In California it is most troublesome in the cultivated lands of the southern part of the state and in the warmer sections of the interior valleys, but occurs as a roadside weed over the greater part of the state.

Bermuda grass can not grow under shade so a good stand of alfalfa or other dense shade crop will generally keep the grass from spreading. A plan of attack often recommended is to plow shallow in spring, harrowing or raking up the plants, which should be burned, as every piece of stem or root is capable of producing a new plant. The field is then seeded heavily to a dense summer crop, such as Sudan grass, sorghum, or cowpeas. When the summer crop is removed, the land is again worked up and in the fall seeded heavily to grain. This should be followed by an intertilled crop which must be thoroughly cultivated to keep down the grass. The crops must follow each other in close succession in order that the Bermuda will not have an opportunity to spread. If the weed is not removed the first season the rotation is repeated.

The roots of Bermuda grass are sensitive to cold; hence in climates where heavy frosts can be depended upon, it can be readily controlled by plowing very shallow, not over two or three inches, in the fall. In this condition, most of the grass will be killed by a severe freeze.

RUSSIAN THISTLE.

(*Salsola kali* var. *tenuifolia*)

In its native home and in the plains region of this country, the Russian thistle has long been a serious weed pest, due to the enormous quantities of seed it produces, to its provisions for scattering them over large areas by becoming a tumbleweed, to its habit of thriving in waste places whence it reinfests farm land, and to the spiny branches which are capable of inflicting severe injuries on men and animals.

From the time of its first appearance in California, in the Antelope Valley, warning pamphlets describing the plant, noting its destructiveness and giving control methods, have been issued by the Agricultural Experiment Station, the State Commissioner of Horticulture and various County Horticultural Commissioners.

The Russian thistle is not particularly troublesome in orchards and intertilled lands, as it is an annual and the young plants are easily killed by tillage operations. The danger lies in the tendency to neglect it along roadsides, fences and ditches, and in waste places, where it often matures seed before it has become large enough to be noticed. The young plants are readily eaten by stock but the sharp spines develop early and are capable of inflicting severe injuries.

A good stand of alfalfa will not be injured by the Russian thistle, but where the stand is weak or the field run down the pest may become established and ruin the field, making it necessary to plow it up and put in a cultivated crop. The plant is extremely persistent in its efforts to produce seed and if repeatedly mowed will at length flower and produce seed below the reach of the mower.

The Russian thistle likewise becomes a pest in grain fields and a grain field so infested should be cut for hay or harvested as early as

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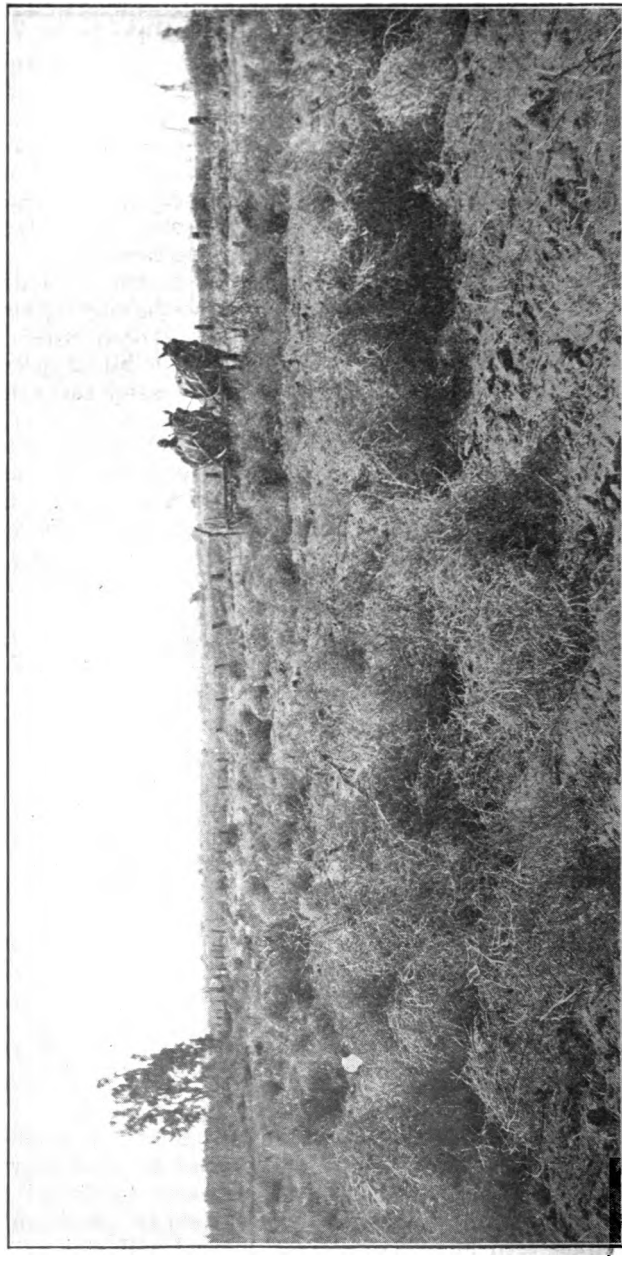

FIG. 127. Russian Thistle (*Salsola kali* var. *tenuifolia*) as it occurs in the San Joaquin Valley. Note adjacent grain fields and infestations beyond the fence caused by not keeping the waste land in the foreground clean.

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possible, preferably with the binder and the field then should be treated to kill the weeds. If some seed has already been formed, the stubble should be fired if this can be done without danger to standing grain.

While the matter of Russian thistle control is a district rather than a county problem, several counties conduct annual campaigns with notable success. Every farmer should be ready to cooperate in exterminating and keeping out the pest. Seed, feed and hay should be watched as possible sources of infestation. Not only is it necessary to prevent a field from becoming infested but the roadsides, ditch banks, fence lines and railways must be watched for plants, which should be cut off below the surface of the ground before they can mature seed. The law assists the farmer by provisions for eradication on public property and on the property of persons unwilling to cooperate.

The Russian thistle is not difficult to destroy; the young plants are not hardy; the seeds are not long lived; the plant does not sprout from the cut root; and it does not live over the winter. It is necessary only to take it in time to destroy it completely.

A good stand of alfalfa planted in a thoroughly prepared seed bed will kill out Canada thistle in the second year. The land should, however, be thoroughly worked over and any thistles which appear should be cut below the surface of the ground with a sharp-nosed shovel. Thistles growing along the fences and roadsides should not be allowed to remain, because the plants spread from the underground roots into adjoining fields.

Chemical weed killers such as salt solution, arsenite of soda (3 pounds to 100 gallons water), iron sulphate (100 pounds to 100 gallons water) and crude oil can be used to eradicate small patches of Canada thistle. These liquids should be applied directly to the plant roots after the tops have been removed. (See discussion under the heading "Herbicides.")

TARWEEDS.

This term is applied to several genera of California plants because of their resinous and glandular, sticky character. They are nearly all heavy scented with odors from rank and nauseating to sweet balsamic. The flowers range from insignificant, almost colorless (*Madia sativa*) to the brilliant yellow and white, Tidy-tips (*Layia platyglossa*) which cover the ground with sheets of color. The plants vary from a few inches to six feet in height, in this form often crowding out every vestige of valuable pasturage. The sticky substance found on leaves and stems smears everything with which it comes in contact. The legs and the heads of grazing stock and sheep are black and dirty after passing through a tarweed infested field. Hayfield tarweeds considerably reduce the availability of the after harvest pasturage thus reducing the value of the land.

Tarweeds seem to be more prevalent on the Pacific Coast than in any other part of the United States. They thrive on the dry fields and pastures of the state and are annually extending their range. In some localities they are apparently harmless but even though stock is not pastured in these places they are impassable to humans without damage to clothing. The seeds of all the different plants coming under the

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general classification of tarweeds are carried by stock, birds, vehicles, etc., coming in contact with the plants at the time when the seeds are mature. Cutting over pasture land to suppress tarweeds should be undertaken before the plants become mature, as the seed ripens on the drying stems. Some tarweeds are perennial and must be plowed to make control effective.

The tarweed problem is like that caused by the Russian thistle and many other annual pests, since every seed is a potential plant and they will grow and thrive on soil too dry for most other plants. They thrive best on the best soils and thus become a considerable burden on summer range and pasture lands. They are spreading rapidly and every effort should be made to keep them under control.

HOARY CRESS.[1]

(*Lepidium draba*)

Fifteen years ago *Lepidium draba* made its appearance between Watsonville and the ocean beach along the Beach road in the moist, alluvial soils of Pajaro Valley. In a few years it spread freely and became recognized as an undesirable visitor. Efforts to control this now-recognized pest failed and all the outside aid obtained was the name and the information that it was a difficult plant to eradicate. It was soon realized that infestation by this plant made summer crops difficult, then unprofitable, and finally, in many instances impossible. Hay sold from infested fields spread the infestation and unclean grain added to its distribution.

When land-holders and tenants realized the problem involved in control of this pest on moist lands some of them began to move away while those who remained undertook the problem as a community affair and sacrificed an entire season to cultivation, to bring the weed under control, and failed. This result was so discouraging that another season's cultivation was not attempted although this might have been successful in establishing control. Of course succeeding tenants made such efforts as they could to secure a living from the soil but the infested lands gave a scant return where much might have been expected had the destructive feeder been destroyed. As a result, hundreds of acres of rich arable land are yielding indifferent crops of foul hay where the same land, cleaned, might be in demand for seed-production, onions, or any other of the more highly profitable crops of the state.

The original infestations owed their introduction to seed in imported lawn grass, alfalfa, and even in flower seeds. One infestation originated from impure beet seed purchased in Ohio. Monterey County's chief infestation has arisen from seed brought by flood waters from San Benito and Santa Clara counties and the same source is a menace as long as the pest is allowed to seed in the drainage area of the Pajaro and the San Benito rivers. For the present, outside the Pajaro Valley, Monterey County, infestations are very small, though some are difficult to reach. There are known infestations near Gilroy and San Jose, in Santa Clara County, and one of several miles in length along the state highway near Chino, San Bernardino County.

[1]By J. B. Hickman, County Horticultural Commissioner, Monterey County.

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Like most members of the mustard family, *Lepidium draba* seeds start with the first rains and extreme frost checks but does not kill the young plants. The past two years have shown that *Lepidium draba* suffers readily from drouth and in a drouth-weakened condition is killed easily by close cutting. Unlike its plant relatives, it does not afford food to stock, which apparently do not eat the growing plant. The writer has seen cows pastured in a city lot eating the surface bare of verdure except blooming stalks of *Lepidium draba.*

The first step in the control of any weed is to stop its spread. Like the morning-glory, the *Lepidium draba* must be controlled both as to underground stems and seed, with this added disadvantage in the control of the latter that its season is much longer, starting growth with the first rains and blossoming far into the summer and, also, that its underground stems are hardier and more persistent than those of the morning-glory. The stems of this plant have been known to force their way through a gravel sidewalk and a street with asphalt pavement, the roots having penetrated underground from an adjoining lot.

No grain or seeds of any plant in areas infested with *Lepidium draba* should be marketed without a clean bill after thorough inspection. Hay from these areas should not be sold for delivery elsewhere. All infested hay should be fed at home. Reference already has been made to the comparative ease with which drouth-weakened plants may be destroyed. In moist lands, however, eternal vigilance must be the practice with the ever-ready hoe or weed-cutter for scattered plants. Burn the plants as nearly as possible where they fall. For the underground stems, thorough cultivation through an entire season will do much and probably a second season of the same thorough work will finish the job in a given location.

Small infestations where isolated may be eradicated by means of carbon bisulfid—inch holes about eighteen inches apart each way and sixteen inches deep into each of which may be poured two ounces of the fluid, then covered.

DODDER.

(*Cuscuta* spp.)

The most important step in controlling dodder is to prevent its introduction in commercial seed. So important is this that many European countries have laws which prohibit the sale of seed containing even one dodder seed in a sample. Every farmer should know what dodder seed looks like, should examine his alfalfa seed before sowing, and should consider it unfit for planting if it contains any dodder seed. The seed laboratory of the State Department of Agriculture examines seed free of charge, reporting the percentage of dodder, other weed seeds and dirt present in the sample as well as the germination. Dodder also may be introduced in hay, manure or irrigation water.

If dodder is to be controlled, it should be immediately destroyed whenever it is found infesting a crop. Every piece of the plant will grow if it can reach a proper host, hence it is easily spread by the mower. If left until the seed is formed the work will not be effective, for dodder seed has been known to remain in the soil at least three years if the proper conditions for germination are not provided. Somewhat

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immature seed, according to tests made by the Vermont Agricultural Experiment Station, appears to germinate fully as well as mature seed.

The simplest way to destroy dodder is to cover the infested patches with straw and burn them. Experiments with iron sulphate, calcium sulphide and other chemicals indicate that they can be used successfully to destroy dodder. The alfalfa, or at least the young shoots, are killed back to the ground by the chemical, but new shoots are immediately sent up from the crown.

If the infestation is general, the only remedy may be to plow up the field. It is advisable to grow Sudan grass or similar cultivated crop for one season or more before sowing again to alfalfa or clover.

If hay containing dodder is fed to stock, care should be taken in disposing of the manure, since the seeds are probably capable of passing through the digestive tract unharmed.

MUSTARD.

(*Brassica* spp.)

Plants of the mustard family are rarely troublesome in cultivated lands where systematic rotation is practiced but are exceedingly difficult to control in grain fields because of the fact that the seed is shattered before the grain is ordinarily harvested. If the field is plowed in the fall, many of the weeds will sprout as soon as the rains start, when they can be killed by disking the land. This will necessitate late seeding, but probably will not be necessary for more than two seasons. If the binder can be used and the field worked up immediately after harvest, any late weeds that may start will be killed.

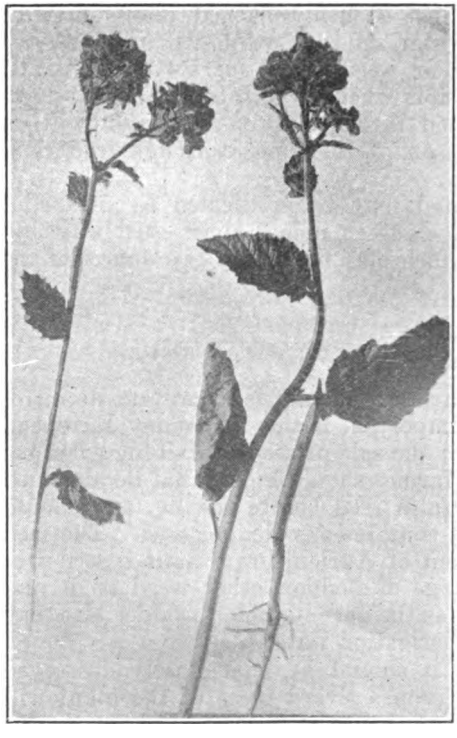

FIG. 128. Black mustard (*Brassica nigra*).

A sulphate of iron spray prepared by dissolving 100 pounds of iron sulphate in 50 gallons of water has proved successful in many states for controlling mustard in grain fields where the weeds are very thick. The most vulnerable stage is just before the mustard blooms. The grain at this time also is usually at a stage when it is least liable to injury. The spray must be fine and mist-like and is more effectively applied on a damp, cloudy day; but the effect is spoiled if rain falls within forty-eight hours after applying. The grain may be blackened, but no permanent injury will result.

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Where it is desired to eradicate mustard or radish in waste places, mowing will not prove of much value, for these plants are very persistent in their efforts to produce seed, and will flower and seed below the reach of the mower. A spray of iron or copper sulphate will be effective; or the plants may be killed by cutting off below the crown with a weed knife, hoe or spud.

KNOTWEED.

(*Polygonum aviculare*)

Knotweed springs up in abundance when an old sod is broken, but the young plants are fairly easily killed by tillage operations. The roots of older plants, however, are very tough and deep rooted, and the cultivator often slips around them. The stems are formed close to the ground and often cause trouble by becoming entangled in the plow or cultivator. The only way to avoid this condition is to place the field in a cultivated crop and cultivate to kill the weeds while they are young.

Knotweed is grazed to some extent by stock. The heavy grazing and trampling which are fatal to most plants do not affect this hardy plant; however, its food value is not great and it may in time take possession and render the pasture worthless. Where knotweed is established in a pasture it is exceedingly difficult to eradicate unless the pasture can be plowed up and cultivated. Heavy seeding to desirable pasture plants and avoidance of overstocking and trampling of heavy soils when they are wet and likely to puddle will help to reestablish the pasture. Applications of lime, gypsum or fertilizer will do much to stimulate more desirable plants and enable them to compete with the weed.

Knotweed also becomes troublesome in lawns, especially in heavy soils, and in walks and drives. (See discussion of weeds in lawns, walks, etc.)

CALTROP OR GROUND BUR-NUT.

(*Tribulus terrestris*)

The puncture vine, *Tribulus terrestris,* was probably introduced into the United States from the Mediterranean region in ships' ballast. Its advent in California is directly traceable to the railroads. In the hot, dry climate and fertile soils of our interior valleys, the plant seems to have found conditions even more favorable to its growth than its native habitat on the borders of the Sahara Desert.

The earliest report of the puncture vine in California was in 1903, when it was found growing along a railway bank at Port Los Angeles. In 1908 it was found in abundance in the Southern Pacific yards at Colton and was also collected near San Bernardino. In 1912 it was reported as a troublesome weed in and about Bakersfield and now is a pest worthy of earnest and very serious consideration in that county. It has spread over a large area in the upper San Joaquin Valley and is found in a nearly unbroken line along the railroads northward to San Joaquin County. In the Sacramento Valley it has been found at Woodland, Durham and Marysville, is reported as widely spread along the railroads in Tehama County and can be found north to the Oregon line through Shasta and Siskiyou counties at practically every station where live stock are loaded into or unloaded from railroad cars.

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South of Tehachapi, the puncture vine is found from the Mexican border through the Imperial and Coachella valleys to the coastward valleys of Riverside, San Bernardino, Los Angeles and Orange counties. It is found in the coastal strip from Los Angeles County to San Francisco at intervals with light infestations. It might safely be said that the puncture vine is found in every county having a main line railroad traversing it and if by chance any county so situated has escaped it is merely a matter of weeks or months until this weed will appear. From the rapidity of its spread in the upper San Joaquin

FIG. 129. Characteristic seed pods of the Caltrop or ground bur-nut (*Tribulus terrestris*).

Valley in the last ten years, it is to be expected that the pest will continue to extend its limits from these newer centers of infestation until something is done to check it.

The plant produces numerous prostrate stems which frequently grow to a length of eight feet. At every joint is produced a number of burs, usually five, which separate as soon as they mature. Each bur possesses two or more sharp spines about the size of carpet tacks, so disposed that however the bur may fall, one spine always will point upward. The spines will pierce and work into an automobile tire, the tread of which is somewhat worn and will readily puncture a bicycle tire.

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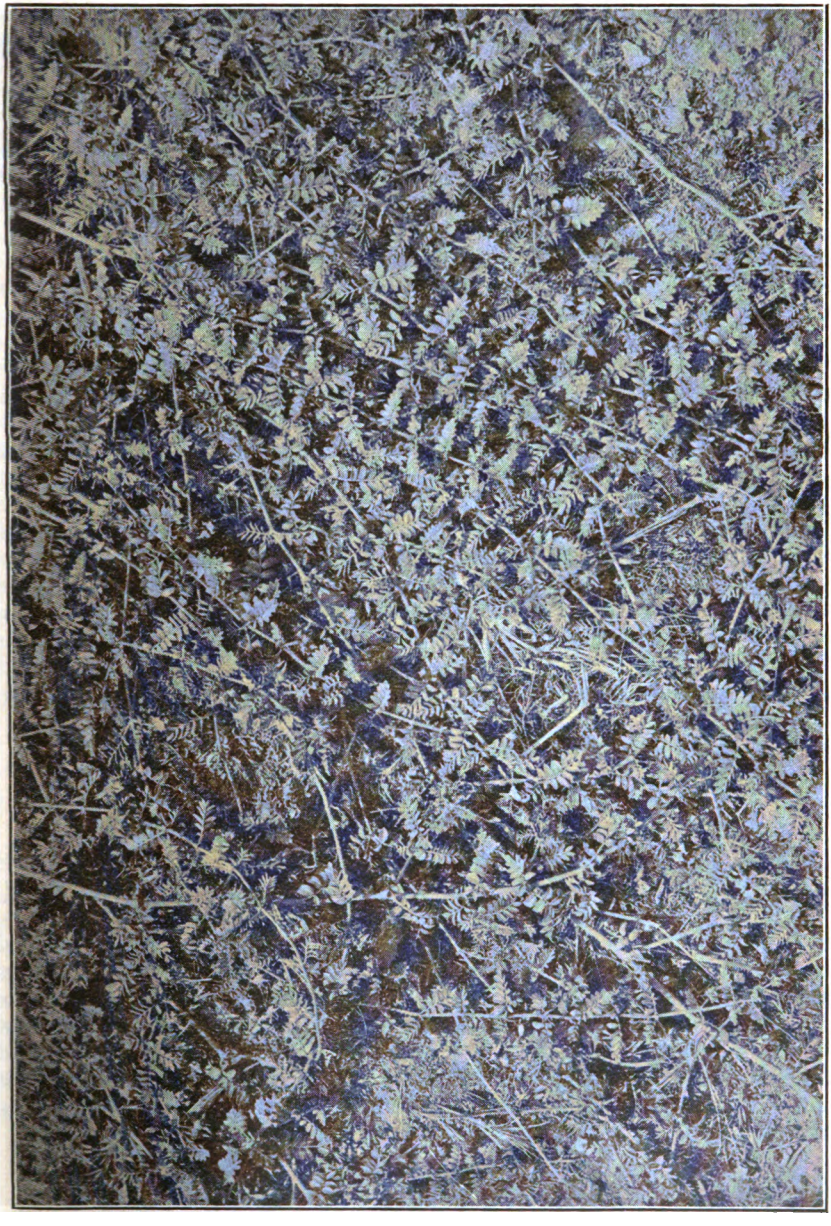

FIG. 130. A few plants of the ground bur-nut, or Caltrop (*Tribulus terrestris*), illustrating how completely they succeed in dominating other plants in the immediate neighborhood. (Photo courtesy Fred P. Roullard.)

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The weed threatens not only the motorist but the farmer as well, since it invades pastures, hayfields and cultivated crops and is capable of inflicting severe injuries upon all classes of stock, especially horses, by piercing the frog of the foot. Intensive farming practices will keep cultivated lands free from weeds but the real problem of the puncture vine is its control in waste land and along roadsides and railroad rights of way. It is important that the people of the state be alive to the urgent necessity of curbing the spread of this vicious pest to the end that they may demand that adequate measures be taken to check it. Drastic measures where the infestations at present are light, most certainly are justifiable.

Wherever it is found it should be killed by severing the top from the root just below the surface of the ground. In fields the plants can be raked together and burned as soon as dry. The flowers appear almost as soon as the first leaves, so seeds are being matured during the entire life of the plant. Cultivation while young is the most effective and economical means of control. About two weeks after the first fall rains, thousands of the seeds will be putting out tender roots and the smallest amount of disturbance at this period in its growth will kill it. Raking will, of course, scatter large quantities of seed, therefore when small patches are found it is suggested that the weeds be severed below ground and allowed to remain where found until dry then sprinkled with a little coal-oil or distillate and burned. To prevent seed production is the most important control measure and the character of the ground and locality will modify the methods that may be practical for this purpose. Every agricultural land owner in California is interested in checking the spread of this pest and should acquaint himself with it in order to recognize it as soon as it appears and stamp it out.

WATER HYACINTH.

(*Eichornia crassipes*)

A Possible Menace to Navigation.

Florists in southern California offer for sale a beautiful aquatic plant called water hyacinth, *Eichornia crassipes* Solms. This plant, so highly prized in aquaria, and its near relatives, the pickerel weeds, have come into ill repute among navigators in tropical and subtropical waters, and more especially in the Gulf States, where the enormous sums expended in clearing streams of this pest have earned it the name of "million dollar weed." The history of its establishment is not known but it was certainly introduced as an ornamental aquatic and is said to have been planted in a pond near Palatka, Florida, where it soon became so abundant as to necessitate control measures and was taken up and thrown into the St. Johns River.

Description.

The plant is a floating perennial, the leaves forming in rosettes usually one to two feet in height from the surface of the water. The leaves are of two kinds: Those below the surface of the water are long and narrow, while those above the water line are usually broad, obovate to nearly circular. The leaf stems are enlarged into oval bulbs filled

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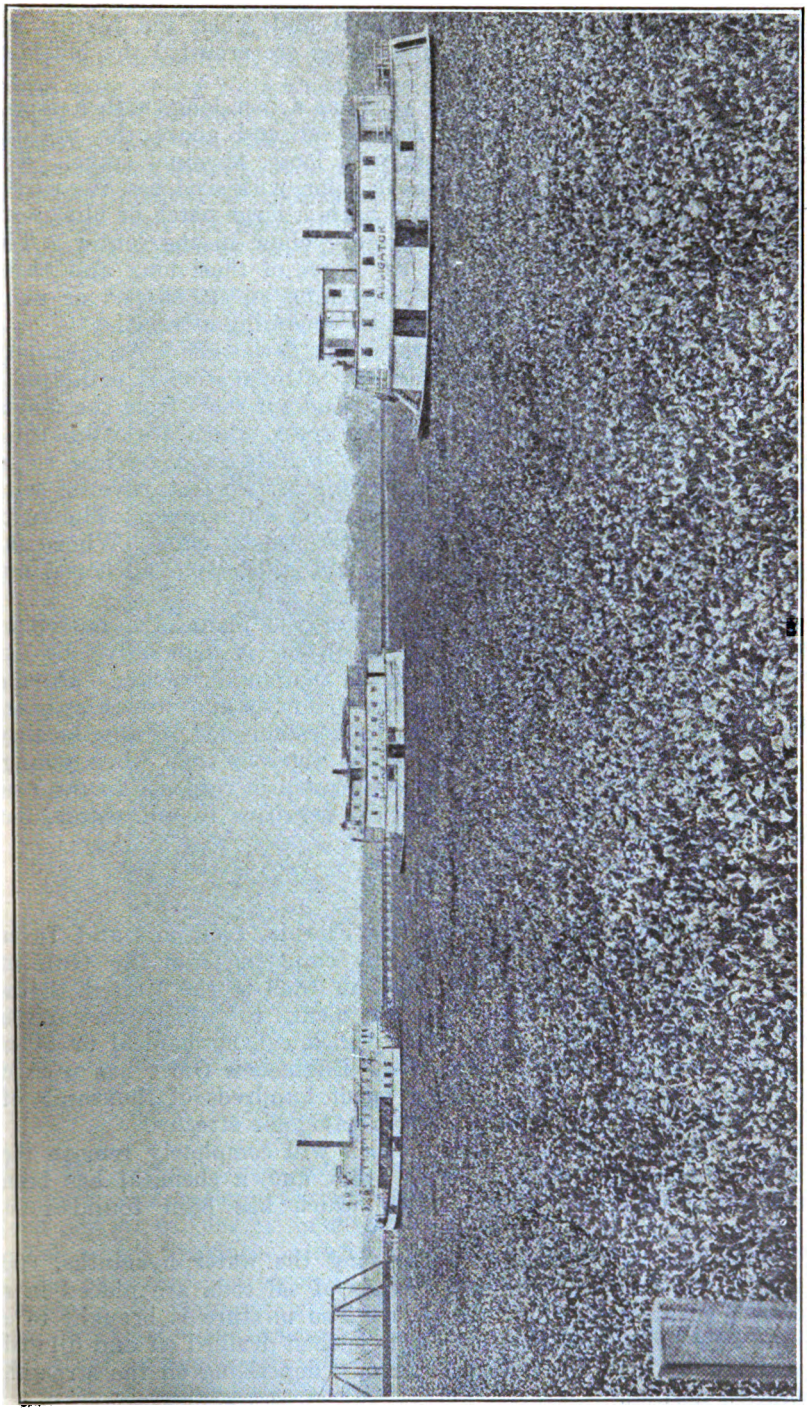

FIG. 131. The St. Johns River, Florida, showing obstruction of navigation by the water hyacinth (*Eichornia crassipes*). This photograph was taken opposite the Palatka Bridge. (U. S. Dept. Agr.)

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with aircells, especially in young plants and when the plants are growing in small groups. When the leaves are crowded the bladder-like petioles are not so large.

The stem which bears the flower is about a foot long, with a single leaf and several wavy-margined sheaths at and above the middle. This stem bears about eight flowers in a loose, terminal spike. The flowers are funnel-shaped, pale violet in color, with six lobes, the upper of which is larger than the others and bears a large patch of blue with an oblong or pear-shaped spot of bright yellow in the center. The stamens are all curved toward the tip, three of them long and three short. The seed pod is three-celled, becoming an egg-shaped or elongated capsule with the withered perianth remaining attached.

As far as known the plant produces but few seeds. At maturity the stem bends so as to immerse the pod. Propagation is principally accomplished by means of runners which send out roots from the nodes.

The roots are of two kinds: Horizontal roots, which are often thick and fleshy and pieces of which will grow readily; and vertical roots, with a slender, wire-like stem, often as long as two feet, covered with small, fibrous roots which give them a feathery appearance. The roots are exceedingly numerous, forming a dense, brushy mass. Where the water is shallow, the roots penetrate the soil and become anchored but in deeper water they float freely.

The tops are easily killed by frost, for the plant is a native of tropical South America but the root system is kept alive by its immersion in water. The growth is most vigorous in spring. During the season of low water the leaves become yellowish and growth appears to be retarded. After the plant has been established in any locality for a number of years, the growth is less vigorous than when young, but after a flood it resumes its vigorous growth in response to the new supply of nutrient material. It is quite sensitive to salt water, but thrives in subsaline or brackish water.

Control.

The water hyacinth is so abundant in Florida, Louisiana and Texas as to obstruct navigation in the waters emptying into the Gulf of Mexico. Its eradication was entrusted in 1899 to the United States Engineer's Office of the War Department, to which was given "authority to remove the plant by any chemical, mechanical or other means whatever." From that time the Engineer's Office has worked continuously on eradication and has spent hundreds of thousands of dollars in attempting to remove it from navigable streams.

No method has ever been found which will completely remove the plant at a reasonable cost, although every known chemical has been experimented with; but the solution which has been found most effective is an arsenical spray.

To make the solution used in spraying the water hyacinths, 600 pounds of white arsenic and 600 pounds of sal soda are placed in a tank with about 600 gallons of water. The mixture is brought to a boil and kept boiling for two hours. It is then drained off and diluted with cold water to 9,600 to 12,000 gallons, depending on the strength of solution desired.

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For spraying the solution over the hyacinths a duplex Worthington pump, 4½ inches by 2¾ inches by 4 inches, is used with one-inch six-ply steam hose and a Fuller nozzle which is designed to give a very fine spray. The pressure on the hose is usually 50 pounds. On warm, sunshiny days, one gallon of the diluted solution is ordinarily sufficient to destroy ten square yards of hyacinths. If the day is cloudy or cool, a larger quantity is necessary. Where the hyacinths are very tall, the spray does not reach the shorter plants, and a second application becomes necessary to reach those not killed at first. In the year ending

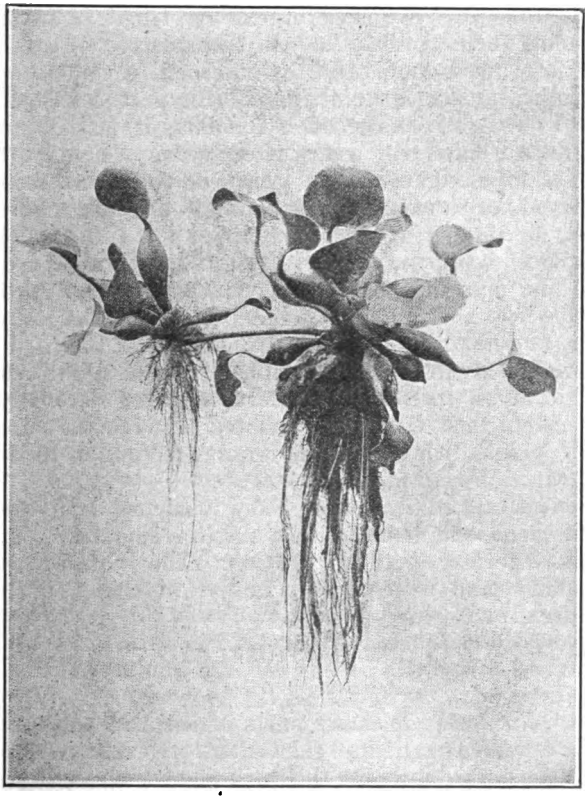

FIG. 132. Bulbous stems and leaves of the water hyacinth (*Eichornia crassipes*).

June 30, 1919, the two barges sprayed 1,613,383 square yards of the hyacinth in Louisiana waters, using 201,908 gallons of solution, at a total cost of $13,464.21, or $0.0083 per square yard.

The water hyacinth is eaten with relish by stock, and in Florida its use as a feed had become so well established that it was considered necessary, in making an appropriation by the Rivers and Harbors Act of 1905 for the removal of the plant from the St. John's River and other navigable streams of Florida, to insert a proviso that "no chemical process be used injurious to cattle." It was at first attempted

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to break up the masses of the plant and push the pieces into the current but this was found unsatisfactory and exceedingly expensive. In 1909 an elevator fixed to a barge was used which gathered the plant in much the same way as kelp is gathered. But this method was soon found to be too expensive. Fixed booms are maintained across non-navigable streams to prevent the plant floating into navigable streams, and movable and semi-automatic booms to prevent its floating from one navigable stream into another. Laborers and watchmen are employed to detect or prevent the spread of the plant.

In the other Gulf states the use of chemicals is not prohibited and although some difficulties are encountered by owners of stock along the streams allowing their animals to eat the sprayed plant, with fatal results, in general local cooperation is obtained in combating the pest.

In spite of the enormous quantities of this pest destroyed annually since the work was first undertaken in 1899, it is still necessary to repeat the control measures year after year. So insidious is this floating menace to navigation that wherever the strictest precautions are not observed, a stream or harbor may be over night rendered impassable.

There are two or three small infestations of water hyacinth in California at the present time but as yet they are confined to places from which they can not escape. If this pest should become established in the sloughs and channels of the Sacramento and San Joaquin rivers there is no way of estimating the damage which might result. It is hardly likely that an infestation could take place naturally but it is extremely probable that it might be started through the careless act of some lover of plants, who, through ignorance, might throw into the stream refuse from the garden.

Aquatic plants are dangerous. They obstruct irrigation ditches, interfere with the development of rice, clog the channels of streams and may seriously interfere with navigation. The water hyacinth is a dangerous aquatic and we earnestly advise watchful care to prevent its further spread.

CANADA THISTLE.

(*Cirsium arvense*)

Canada thistle is found in many parts of the East and Middle West, in Canada, Europe, Australia and the Orient. Nearly every state in the United States has passed laws for the purpose of keeping it out. Nearly every European country has wrestled with it, and the Canadian government has carried on a very persistent fight against it. Without doubt, it is one of the most troublesome weed pests known to agriculture. It does not even have the redeeming feature that it can be eaten by stock, as its leaves are so sharp and thorny that few animals will touch it. It is a perennial plant, growing from long, deep-rooted underground stems or root stocks. It spreads from these root-stocks very much as does Bermuda grass or Johnson grass, each cut joint being able to produce a new set of plants.

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Description.

The Canada thistle is a true thistle as distinguished from many so-called thistles, like Russian thistle and others. It can easily be recognized by its sharp, spiny, vivid green leaves and bright purple flowers and its long underground roots. In the spring a dense cluster of long, irregular leaves first appears close to the ground; the margin of each leaf is lined with sharp spines. Later the flower stalks appear. These are at first somewhat weak and spindling but later strengthen. The branches blossom profusely, resulting in a very attractive plant. The plants are partially dioecious, usually having male flowers on one plant and the female on another. The male flowers are much more globular than the female and of a deeper color. They are nearly always purple, though occasionally white flowers will be found. The seed is comparatively smooth, of a light brown color, generally slightly curved. The apex is cup-shaped, with a pointed tubercle in the center. The body of the seed tapers slightly to the base, which is rounded. Due to its dioecious habit, a considerable portion of the seed is sterile. The root of Canadian thistle is what makes it such a serious pest. It grows rapidly and extends into the soil, sometimes to a depth of two and three feet. When cut it is capable of reproducing new plants without any apparent check to the growth.

Methods of Distribution.

Like all thistles, the seeds of Canada thistle are spread by winds, birds, threshing machines, sheep and hay, in agricultural seeds and in manure. To eliminate distribution by means of seed the most important thing is to prevent seed development.

The underground roots provide another and in this state, the principal means of dissemination. Any cut portions of these will produce new plants. Careless plowing, threshing machines, harrows and plows passing from field to field often spread the roots over a wider territory. In this way many infestations of Canada thistle, as well as morning-glory, Johnson grass, star thistle and quack-grass, have been spread from farm to farm. It is unwise to allow any farm machines, especially hay balers, threshing machines and the like, to come onto the farm without being cleaned. Greater care in farming will mean fewer weeds. Farmers writing contracts for harvesting, threshing or baling should have in the contract a clause requiring that machines be cleaned before coming onto the place.

Control.

Ideas differ materially regarding the possibility of eradicating such pests as Canada thistle, but there is no doubt that if the proper methods are used it can be done. Many other states have wrestled with the problem with success where the cooperation of the farmers was secured. Canada thistle occurs in only a few places in California at the present time, so we believe it can be successfully eradicated.

1. Plow shallow and harrow as soon as possible after harvesting whatever field crop is grown. The exact location of the infested spots should have been previously marked so that the spot can be harrowed with a springtooth or a light cultivator during the summer and fall. After

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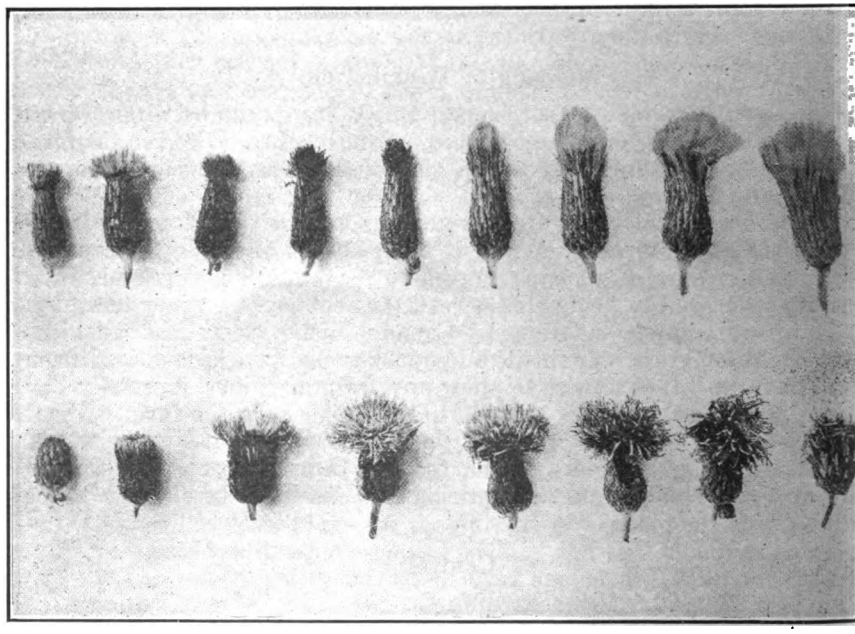
the first rain falls, plow deep and turn all roots to the air, removing as many as possible. Allow the land to lie thus through the winter. In the following spring, plowing and harrowing before the grain is put in will eliminate many young sprouts which have started during the warm winter days.

It must be understood that the idea of such frequent plowings is to keep all green leaves out of sight. The roots will continue to send up shoots until their stock of food is exhausted, when they will die. It is the green leaves which gives the roots new life.

2. If the infestation is very bad, hoe-crops should be planted in the spring instead of grain. The careful cultivation required to bring these to maturity will eliminate what thistles still retain life after the treatment outlined above.



Heads of Canada Thistle in the order of their stage of development. Top row, female; bottom row, male.

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RICE WEEDS.

By Prof. P. B. Kennedy, Berkeley, California.

Rice is an expensive crop to produce and requires much skill and attention. In some instances large profits are made and it is these which we are most apt to hear about. One of the most serious losses is caused by weeds. These losses may vary from a few dollars per acre to a total loss of the whole crop. If weeds are left to grow, they may reduce the yield, delay the maturity of the crop by shading and add expense in weeding, harvesting, binding, sacking and hauling worthless weed seeds. A lower price is obtained for the product as it necessitates extra cleaning and extra care in milling.

Weeds are troublesome in rice sections in the canals, laterals, ditch banks and levees but more especially when they grow in the checks along with the rice.

The sources of infestation of rice fields by weeds are (1) through the seed rice, (2) through the irrigation water, (3) by birds, and (4) by wind. Seed rice from foreign countries, being planted as individuals from a seed bed and the mature crop also harvested by hand, is less likely to contain weed seeds than when the crop is seeded and harvested by machinery.

The weeds most to be feared are those which will grow in water, requiring conditions similar to rice. As there can be no cultivation of rice after it is planted, the seed and seed-bed must be free from noxious weeds and contamination from weed seeds in the irrigation water prevented. The enormous increase of weeds in the rice fields the second and third years can be explained by the large number of seeds which even a single plant will produce if allowed to mature. Chamliss and Adams have estimated that a single plant may produce as many as 40,000 seeds. An average sample of water-grass seed germinates about fifty per cent. Ditch banks and canals are frequently foul with weeds, the seeds of which may be carried along with the water during the entire irrigation period, as rice after a certain stage of growth requires a continuous flow of water into and out of the fields. The accumulation of weed seeds under such circumstances must be large.

An example of a weed that is largely spread by the wind is the cat-tail (*Typha latifolia*). The seeds of this weed germinate readily in moist soil and, being light and fluffy, are carried for long distances. A single flowering stalk contains hundreds of thousands of seeds. We have many times seen shocks containing more cat-tail than rice. In some cases the whole field has been abandoned because of this serious pest.

It is difficult to determine out of the hundreds or more weeds found on the ditch banks and levees and in the fields and canals, which ones will suddenly become aggressive and be placed in the category of bad rice weeds. We are all familiar with the water-grass (*Echinochloa crus-galli* and varieties) and the cat-tail (*Typha latifolia*), and feel to a certain extent that if we could only get rid of these pests, our troubles would be over. Yet, there are a number of very innocent

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looking plants, such as the red-stem (*Ammannia coccinea*); the spike grass (*Leptochloa fascicularis*); joint grass (*Paspalum distichum*); the umbrella plants (*Cyperus* spp.) and the spike rush (*Eleocharis palustris*), that need very little encouragement to produce seed abundantly, to become serious pests.

The following is a list of the most troublesome rice weeds:

Water-grasses, *Echinochloa crus-galli* and varieties.
Cat-tail, *Typha latifolia.*
Red rice, *Oryza rufipogon.*
Joint grass, *Paspalum distichum.*
Red stem, *Ammannia coccinea.*
Scale grass, *Leptochloa fascicularis.*
Canary grasses, *Phalaris paradoxa, Phalaris brachystachys.*
Umbrella plants, *Cyperus erythrorhizos.*
Umbrella plants, *Cyperus virens.*
Umbrella plants, *Cyperus diandrus* var. *castaneus.*
Spike-rush, *Eleocharis palustris.*
Large indigo weed, *Sesbania macrocarpa.*

WATER-GRASSES OR BARNYARD GRASSES.

(*Echinochloa crus-galli*)

and varieties.

There are several kinds of water-grass in the rice fields: (*a*) An early form which is comparatively short and which matures and drops its seed before the rice is headed out; (*b*) a mid-summer form which

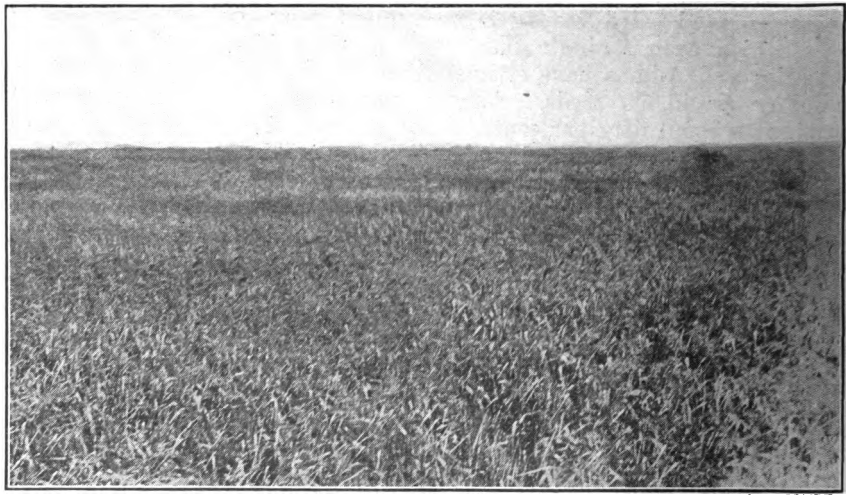

FIG. 133. A foul rice field containing large quantities of water-grass, umbrella plants, cat-tails and other weeds.

heads out just before the rice, but which drops most of its seed before the rice is harvested, and (*c*) a late form which is in full seed at the time the rice is cut and harvested.

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These water grasses are annuals, some of the forms being native to the old world and others to the United States. They occur throughout the United States in moist fields, along irrigation ditches, creeks, rivers, sloughs or flooded areas. In some sections they are abundant in the alfalfa fields. From the crown of a single plant there may ascend as many as fifty upright stems growing from one to six or more feet. The seeds germinate at about the same time as the rice and grow simultaneously with it for a period of time. Later the water-grass surpasses the rice in growth.

Cutting the grass off above the crown only acts as a sort of pruning, giving it new vigor to produce another crop of stems and seeds.

The seed has several coverings, the first three being easily rubbed off with the bristle or awn when present, leaving the shiny interior coats which enclose the kernel.

Little information is available as to the period of rest required by water-grass before it will again germinate. Experiments by Pammel and King in Iowa indicate that seeds subjected to freezing and thawing in the soil germinate better than those stored in the laboratory.

CONTROL OF WATER-GRASS.

Water-grass, although generally regarded as a weed, has some forms that have been used to a considerable extent as forage. When used in this way the term "Barn-yard Millet" is given. In parts of Asia the poorer classes use the kernel as food. One of the varieties of the

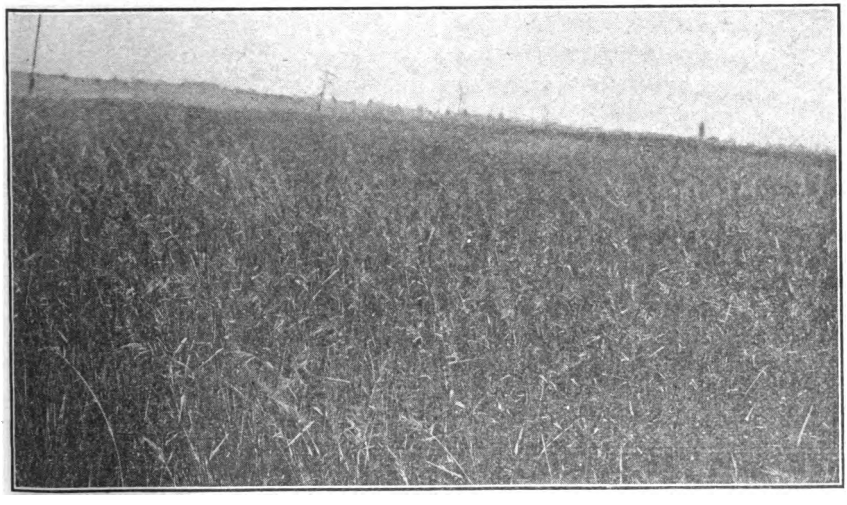

FIG. 134. Was clean for several years, now foul with water-grass.

Southwest, thought to be native and called "ankee" by the Mojave Indians, was at one time made into flour. In the irrigated sections of the North and Northwest it is becoming quite common, and is cut for hay. Griffiths reports a considerable area on the Malheur River, Oregon. It was evidently introduced with alfalfa seed and on account of over-irrigation took the field. It was cut for hay and yielded about

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two tons per acre. We have seen dense stands along roadsides in the rice sections of California, capable of being mowed, that if cut for hay when young would have made good feed for stock, or if when more mature put through a cutter and made into silage, would be profitable. Water-grass makes very fair pasturage. Numerous writers make the statement that stock are fond of it. We have mentioned the good points of water-grass so as to indicate that some returns could be obtained by cutting it before it goes to seed, thus reducing the total quantity of seed produced in a season.

There is no one method that has yet proven wholly satisfactory for the control of water-grass. The long growing season of rice, the heavy soil, insufficient drainage, and the tenant farmer, make the question of weed control a particularly difficult one. Methods that might be

FIG. 135. Typical mass of water-grass (*Echinochloa*).

suggested are: (1) burning, (2) plowing and disking, (3) rotation of crops, (4) hand weeding, (5) flooding to encourage germination, and (6) submerging.

Burning may kill some weed seeds, but it is doubtful if it is to be recommended, as it destroys much organic matter that is valuable in heavy soils.

Fall plowing will cover many weed seeds too deeply for germination, and a late discing in the spring, before the rice is planted, will kill many young, weedy plants at their most tender stage of growth.

Rotation is one of the best methods of controlling weeds. In order to successfully rotate rice with other crops, it is necessary to have control over both irrigation and drainage. Both of these factors present many difficulties over much of the rice area. No definite recommendations, based on satisfactory experimental evidence can be given. The following crops are mentioned as worthy of trial: Wheat, oats, sorghums, sweet clover, soy beans, cowpeas and vetches.

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Hand weeding, before the grass heads out, may be resorted to when the fields are not too heavily infested. The plants should be cut off with a short, curved knife about two inches below the crown. These should be removed from the field, as they will continue to grow if they are left in contact with moisture. The cost of eradication by this method may vary from $2.00 to $20.00 per acre.

Summer flooding, once in June, to germinate all the weed seeds on the surface, followed by plowing, will destroy most of the weeds. A second flooding in August with subsequent shallow-plowing or discing will destroy those that may have been brought to the surface by the previous treatment.

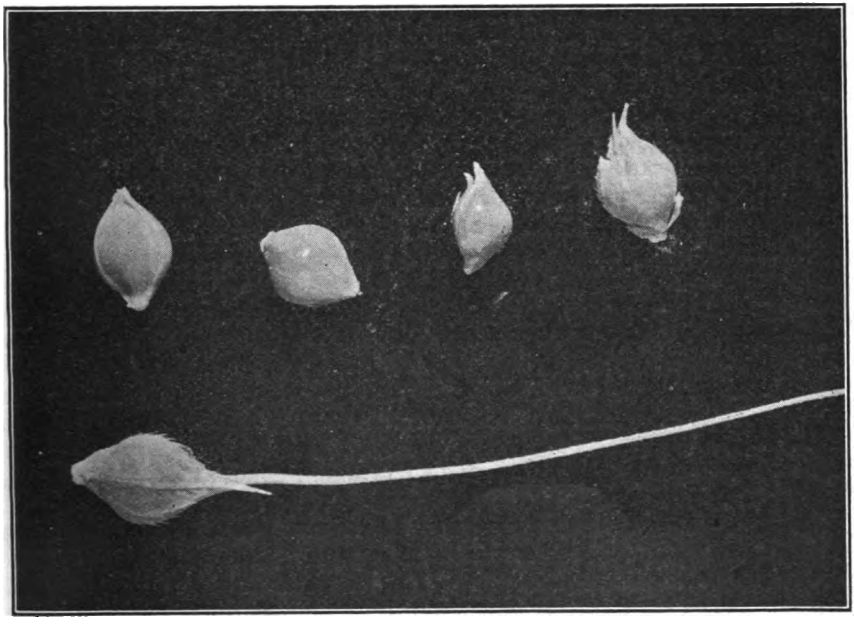

FIG. 136. Seeds of water-grass (*Echinochloa*).

Submergence of water grass when young with a depth of water that will not interfere with the growth of the rice, but suffocate the grass, seems to give the greatest promise of success as the cheapest and best method of control. Rice may be grown to full perfection in water throughout its life period. The reason for unwatering rice is largely to accommodate the harvesting machinery. Water-grass is not strictly a water plant and suffers when covered with water during the early stages of its growth. The preparation of the land, the time and method of seeding and the methods of submergence have not yet been fully worked out.

A committee of investigators from the University and the United States Department of Agriculture cooperating with the rice growers are now at work on a plan of experimentation with the object in view of attempting to solve some of these problems.

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CAT-TAIL.

(*Typha latifolia*)

The term "tule" is sometimes erroneously given to this plant. It is best known and recognized by its brown, cylindrical, compact, flower head, which is from 3 to 6 inches long, on the end of a stem 4 to 8 feet high. These are frequently gathered and variously colored for room decoration. Each brown head consists of hundreds of thousands of seeds. They are smaller than the head of a pin, with several slender, cottony appendages. The cottony masses often seen along the roadsides in late summer are usually the seeds of the cat-tail. The seed is so light that it can be readily blown by the wind for miles. The plant grows very rapidly from seed in a single season, exceeding that of the rice at harvest time by a foot or more. The broad, flat, green leaves seen among the rice are those of the cat-tail. It does not produce the flower heads the first year. In our experiments in the greenhouse it was found that no germination took place except where the seeds were submerged or kept continually moist. By taking a pinch of the cottony mass containing the seed and planting it in the soil of submerged pots, a dense growth of small cat-tail plants was readily obtained.

The cat-tail is a perennial occurring in the marshes throughout North America, except in the extreme north. It is quite abundant in marshy places in the Sacramento and San Joaquin Valleys. The conditions existing in the rice sections are ideal for its best growth. It seems somewhat ludicrous to attempt to rid rice fields of the cat-tails, when many roadsides, waste places, canals, etc., are producing millions of seeds to reinfest the lands. Control must consist of ridding such places of the plant, or at least preventing them from going to seed. Plowing in the fall to expose the upturned roots to frost, followed by discing in the spring to bring the roots to the surface and expose them to drought, will be found helpful.

Where dense stands have become established, cutting and burning the tops, followed by the removal of the roots with a large, strong fork has proven efficacious. The fork is driven into the springy sod and fastened with a chain. A team is hitched on and the mass of roots taken out rapidly and satisfactorily. Where feasible, plowing and scraping may also be found advantageous. Drainage is essential for permanent eradication.

RED RICE.

(*Oryza rufipogon*)

This is the world-wide pest of rice. It is considered to be the most widely distributed and the most difficult to deal with of all the rice pests. It has made its appearance in the rice sections of California.

The plants resemble those of white rice very closely. They are usually more aggressive, however. The stems have a tendency to stool at an angle rather than erect, and the leaves are darker green. The head is more spreading, and the kernel has a reddish coat. The nutritive value of white and red rice is about the same but the objection comes from the millers, who have to grind off the red coat or it will be refused by the public. The seed shatters readily and is said to remain in the ground, increasing the difficulty of eradication. The

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problem in Cailfornia at the present time is to locate the infestations and weed them out by hand. Care should be taken to use seed rice that is free from red rice.

JOINT-GRASS, KNOT-GRASS.

(*Paspalum distichum*)

Joint-grass may be found in shallow ditches, margins of canals, and in swampy places, throughout the Sacramento and San Joaquin valleys. It is becoming more abundant each year in the rice sections. This grass is palatable and valuable when grown in accessible places. The seeds form a large proportion of the food for ducks during the shooting season. Although a moisture-loving plant, it is remarkably drought resistant, the creeping stems remaining succulent on heavy, dry lands for several months. It is a strong perennial, each portion of the plant rooting like Bermuda grass. To eradicate it, it would be necessary to leave the land fallow during the summer, plowing and cultivating repeatedly at considerable expense.

RED STEM.

(*Ammannia coccinea*)

This is not an uncommon plant in swampy places in the San Joaquin Valley. It has now found its way to the rice sections, where it is extremely abundant in the rice. It is not ordinarily observed when looking at a rice field, as it does not usually appear above the rice. It is recognized by its reddish stems, particularly at the time of cutting the rice. There are numerous small capsules at the axils of the leaves, which are filled with a powder-like mass, which constitutes the seeds. The chief complaint against red-stem is that it takes up space that should be growing rice plants. Its seed is separated from the rice at the time of threshing without difficulty.

SCALE GRASS.

(*Leptochloa fascicularis*)

Scale grass is a common grass in ditches and wet places throughout the interior valleys of California, and usually associated with alkaline soils. It is becoming more and more abundant in the rice sections each year. The grass grows to a height of about two and one-half feet, sending up a number of erect stems, each terminating in an open-branched spike of flowers.

A related species, and looking very similar to it is *Leptochloa imbricata,* common in the Imperial Valley, where it is locally known as "water-grass."

This grass is readily spread by irrigation, but the seeds are much smaller than rice and easily separated from it.

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CANARY GRASS.

(*Phalaris* spp.)

These are introduced annuals, native of the Old World. The flower is in the form of a head, resembling timothy, hence the popular name, "California Timothy." The species abundant in the rice fields are *Phalaris brachystachys* and *P. paradoxa.* They are chiefly troublesome in the spring when the rice is germinating.

UMBRELLA PLANTS.

(*Cyperus* spp.)

The term sedge is used frequently for these plants, but as that is also used for the genus *Carex,* of which we have several hundred species in the United States, it would avoid confusion if the sedges could be confined to that large group. Galingale is the common name used for *Cyperus* in many text books, but the name is never used in common parlance, nor does it seem appropriate. They are steadily increasing in numbers in the rice districts and are extending from the ditch banks and laterals into the rice fields.

The flowers are borne on the end of the stem on branches arranged very much like the ribs of an umbrella when it has been inverted by the wind. They produce an abundance of very small seeds which are readily separated from the rice at threshing time.

The species now most abundant are: *Cyperus erythrorhizos, C. virens, C. diandrus* var. *castaneus.*

SPIKE-RUSH.

(*Eleocharis palustris*)

The spike-rush is erroneously called "wire-grass." It is abundant in ponds, swamps and marshes throughout the interior valley. It spreads underneath the soil by means of perennial, horizontal root-stocks. The hollow, soft stems are from one to several feet high, almost round, about one-eighth of an inch in diameter and without leaves. When dry they are very light. Terminating the stem is a small spike of flowers which soon turns brown and disappears. It is troublesome chiefly in places where the water is allowed to become stagnant. It soon takes possession of abandoned rice fields, where the drainage is poor.

LARGE INDIGO WEED.

(*Sesbania macrocarpa*)

This is one of the most common weeds in the rice fields of Texas and Louisiana. The Louisiana Experiment Station estimates that a single plant is capable of maturing 100,000 seeds. It grows from eight to fifteen feet tall and may have a stem two or three inches in diameter. Since it makes a rapid growth, it is one of the first weeds to appear above the rice. Hand pulling is the only method of control.

So far as we know, it has not made its appearance in the Sacramento Valley rice sections but it is a common weed in the Imperial Valley and would, no doubt, soon establish itself in the rice fields of that section as it has in the southern states. The plant grows equally well on wet or dry soils. It is a legume.

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IMPURE SEEDS, A SOURCE OF WEED PROBLEM.

By ETHELBERT JOHNSON, Sacramento, California.

It is obvious that any successful plan of weed control must combine with it careful attention to the weed seeds present as impurities in commercial seed.

The agitation in California for pure seed has resulted in a general demand on the part of farmers for better seed and in the passage of more or less effective laws controlling the sale of seed in most states.

HOW THE FARMER MAY AVOID IMPURE SEEDS.

What is good seed? Good seed should be true to name; practically free from foreign seeds and inert matter; free from insect pests and diseases and should be heavy for the variety, dry, vigorous, and bright. The farmer can not tell by the appearance whether his seed is true to name and he can not always detect insect pests and diseases. But he can learn to tell by the appearance whether it contains many impurities and whether it is heavy and plump.

Examine the seed. Dirt purchased at the price of good seed is expensive. Impure seed not only makes the farmer pay for something of no value but it may bring noxious weeds to his land. It is not to be expected that every farmer should know the various weed seeds but a careful examination, with the aid of a small hand lens, will show whether or not the seed contains many impurities.

Seeds may be tested free of charge. The seed laboratory of the State Department of Agriculture is equipped to test seeds for farmers and seedsmen free of charge. A restriction, however, will be made on the number of samples any one person can submit in a month. Reports on samples will show the percentage of purity, the approximate total percentage of weed seeds and foreign substances, together with the approximate percentage of noxious weeds listed in the Pure Seed Act, the approximate total percentage of germination and, in the case of legumes the number of hard seeds.

To obtain a fair sample from any bag of seeds, a small quantity should be taken from the top, the middle and the bottom of the bag, by means of a sticker or seed trier and the seeds from these three should be thoroughly mixed. In larger quantities than bags, slightly different methods should be used, description of which can be obtained from the state seed laboratory upon application.

What is good seed worth? The value of any seed for planting may be calculated by multiplying the percentage of germination by the percentage of purity. Thus, if seed is 94 per cent pure, and germinates 89 per cent, its value, compared with 100 per cent seed, will be 94 X 89 or 83 per cent. If the impurities, however, are noxious weed seeds, the value is much lower. Alfalfa seed containing even a few seeds of dodder should be considered unfit for planting.

Buy only the best seed. None but the best is good enough. High priced seed may not always mean good seed but cheap seed nearly always means poor seed. The farmer must be willing to pay a fair price for good seed. The seedsman will sell the kind of seed that is in

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demand. If the farmer is unwilling to pay the price of good seed, he will get cheap seed, which means poor seed. There are unscrupulous seedsmen but the majority of established seed houses have a reputation to make and to maintain. The price of good seed purchased from a reliable dealer includes the cost of years of experience with growing and buying seeds and the expense of careful selection over a period of years, as well as the actual cost of growing the seed. It includes the cleaning and recleaning, the packing and the advertising. A dishonest seedsman, one who is careless in buying or who misrepresents his goods, can not long survive in business, except through the patronage of the careless farmer who buys without examining his purchase or the ignorant farmer who seeks to economize by purchasing cheap seed.

WEED SEEDS IN THRESHED GRAIN.

If there are weeds in your grain fields every effort should be made to remove the seeds at the time of threshing. Your combine or stationary machine is equipped with screens for this purpose. Do not cover the screens with canvas or tin—a method too often followed. The United States Department of Agriculture has developed a special attachment to aid in the removal of weed seeds at the time of threshing. Some of the manufacturing companies are attaching this device to the machines they are now placing on the market. The seed should be carefully collected in order to prevent reseeding the field.

The advantages of clean threshing are many and should be very apparent. Under established grading methods a large proportion of weed seeds are removed as dockage and bring no returns to the farmer. If inseparable seeds are present they may be the cause of lower grading and so lower the value of the grain. Screenings removed at the time of threshing—or cleaned out at the local elevator and returned to the farmer—are valuable as feed. However, these screenings should be ground or treated before feeding.

If the weed seeds are *not* removed in the threshing the farmer loses money not only from dockage but in transportation. If his grain shows a presence of 1 per cent dockage (not considering at all the inseparable seeds) it means that if he grew 100 tons of grain he had 2000 pounds of screenings; 500 tons of grain he had 10,000 pounds of screenings; 1000 tons of grain he had 20,000 pounds of screenings.

The farmer hauls this extra tonnage of screenings to his railroad station; if he uses sacks he pays money for sacks to hold the screenings; certain charges are made for warehouse or elevator costs; freight is paid to the terminal—and in the end—they are of no value. If we consider only one particular lot of grain the loss may seem small but when we consider the total grain tonnage moving from the farms to the consumers the enormity of the loss becomes apparent. This loss and economic waste is unnecessary and should be avoided and can be if simple methods of control are used.

Home testing of seeds. Those interested in the testing of seeds should write to the Division of Publications, U. S. Department of Agriculture, Washington, D. C., for a copy of Farmers' Bulletin 428, Testing Farm Seeds in the Home and in the Rural School, which is sent free on application. The seeds which it is especially important

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to test are those of alfalfa, sweet clover, grasses and other small seeded forage crops, and the small grains.

Purpose of seed tests. (1) To ascertain whether the seed is true to name, except as to variety.

(2) To ascertain whether the seed has been intentionally adulterated. (Adulteration, except by seed of the same variety but of lower vitality, is no longer a common practice.)

(3) To determine the relative proportions of inert material and of foreign seed.

(4) To disclose the presence of noxious weed seeds.

(5) To learn by the nature of its impurities, the probable source of the seed.

(6) To determine the amount of viable seed, and the amount of hard seed present.

APPARATUS USED IN MAKING TESTS.

(1) A balance. Directions for making a simple and efficient balance are given in Farmers' Bulletin 428.

(2) Weights. Common "BB" shot may be used if standard weights are not available.

(3) Forceps.

(4) Magnifier.

(5) Paper tray.

(6) Germinator. This may be made from common plates and blotting paper or flannel.

METHODS OF TESTING.

(1) *Test sample.* The sample should be drawn by taking a small quantity from the top, the middle, and the bottom of the bag and from several bags of a lot. An amount equivalent to a teaspoonful of larger seeds should be taken for the test sample and weighed.

(2) *Trueness to name.* The seed should be examined closely to see whether it is of the kind it is purported to be.

(3) *Purity.* All foreign seeds, except adulterants, and all inert matter, such as stems, dirt, or broken seeds, should be separated from the pure seed, which should include shriveled as well as plump seeds. The weight of impurities divided by the weight of the test sample gives the percentage of impurities.

(4) *Adulterants,* being of approximately the same weight as the crop seed, can be determined to better advantage by count than by weight. One thousand seeds of the mixed crop and adulterant should be taken, and the adulterant counted. The number of seeds of the adulterant divided by 1000 gives the percentage of adulterant.

(5) *Weed seeds.* A knowledge of weed seeds is valuable in this connection. The presence of such noxious weed seeds as dodder, Russian thistle, or morning-glory, greatly influences the value of the seed.

(6) *Germination.* In testing germination it is advisable to take duplicate samples each containing 200 seeds of small seeded crops and 100 seeds of larger seeded crops. It is important to count the seed just as it comes, in order to make an accurate test of its germinating powers. The germinator may consist of a piece of flannel or blotting

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paper placed in a shallow dish. The seed should be spread out uniformly on the blotter or cloth, and covered over with another blotter or piece of cloth and another plate placed over the whole. Water enough to keep the seeds moist throughout the test should be supplied but the seeds should not stand in water. A place should be selected where the temperature is fairly uniform day and night. The seed should be examined daily. The length of time the test should continue varies with different seed.

(7) *Purity tests without a balance.* A slightly rounding teaspoonful of alfalfa, clover, and other small seeded legumes weighs approximately five grams. On this basis, a table has been compiled whereby the approximate percentage of many common weed seeds can be determined by counting (see Table VI).

TABLE VI. *Number of Various Weed Seeds in a Slightly Rounding Teaspoonful of Alfalfa, Clover or Other Small Seeded Legumes Required to Make 1 Per Cent of the Sample.*

Prickly pigweed, *Amaranthus retroflexus*	134
Ragweed, *Ambrosia artemisiaefolia*	18
Mayweed, *Anthemis cotula*	210
Wild oats, *Avena fatua*	2
White mustard, *Brassica arvensis*	25
Black mustard, *B. nigra*	64
Pigweed, *Chenopdium album*	72
Bull thistle, *Cirsium lanceolatum*	23
Morning-glory, *Convolvulus arvensis*	2
Dodder, *Cuscuta arvensis*	84
Dodder, *C. trifolii*	192
Nut grass, *Cyperus esculentus*	27
Wild carrot, *Daucus carota*	62
Crab grass, *Digitaria sanguinalis*	182
Water grass, *Echinochloa crus-galli*	70
Peppergrass, *Lepidium* sp.	126
Black medick, *Medicago lupulina*	34
Sweet clover, *Melilotus alba*	24
Rib grass, *Plantago lanceolata*	57
Rugel's plantain, *P. rugelii*	85
Black bindweed, *Polygonum convolvulus*	11
Lady's thumb, *P. persicaria*	36
Sorrel, *Rumex acetosella*	100
Curled dock, *R. crispus*	36
Brown pigeon grass, *Setaria glauca*	20
Green pigeon grass, *S. viridis*	40
Catchfly, *Silene* sp.	45

(From Weeds of Farm and Garden by L. H. Pommel, page 30.)

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COLLECTING AND PRESERVING PLANT SPECIMENS.

By O. W. NEWMAN, Sacramento, California.

The writer has observed in his experience as a member of the State Department of Agriculture that of the numerous specimens sent in for identification very few are in sufficiently good shape to be used when they arrive. This is also true of the samples of twigs, branches and roots which are received almost daily for determination of pests, fungous diseases and physiological difficulties, the latter term being designed to cover all cases which can not be answered with safety in other ways.

Several of the county horticultural commissioners and farm advisers have made collections of the native flora, including the various weeds and shrubs, and of the cultivated plants used commercially in their counties. Collections also have been made of the noxious weed seeds found in agricultural seeds. This is a splendid plan and one which deserves careful consideration and help, both from the universities and the state. In view of these facts, and in the hope also of helping some to a better knowledge of how to collect specimens of plants and seeds both for shipping and for preservation, the following directions are given:

FIELD EQUIPMENT.

Vasculum. A collection can be made without tools or collecting paraphernalia but to get the most satisfactory results, certain equipment is necessary. A collecting can, or vasculum, is the most satisfactory container in which to bring tender specimens into the laboratory in good condition. This is a tin box 18″ x 6″ x 3″, convex on one side and flat, or nearly so, on the other. A lid opens along one side, being fastened by a wire or tin clasp. Hooks or rings for a strap are usually attached to enable the carrier to sling it over his shoulder, out of the way. This box, provided with a little moist moss or some green leaves, will keep tender specimens fresh for hours.

Portfolio. Besides the vasculum, a field book or portfolio is often carried. This consists simply of two flat boards, as light as possible, or two heavy pasteboards, size about 16″ x 12″, with a shawl strap or other means of holding them together. With this field book should be included several sheets of newspaper to keep specimens separated and slips of blank paper on which to make temporary notes for each specimen on the locality where collected, date, and conditions of growth. A hand lens also should be a part of every equipment.

It is also advisable to include such minor articles as a strong knife or a small trowel, for digging up roots which can not be pulled up by hand, wide-mouthed bottles for bringing in algæ and other small water plants and a supply of grocers' paper bags for mosses and lichens, or for seeds. To know the seeds of weeds is almost as important from an agricultural point of view as to know the plants.

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LABORATORY EQUIPMENT.

Press. For preserving the specimens obtained a press is the first requisite. It can be made of anything from a pile of books to a first-class machine. One which many have found valuable consists of a platform, 20″ x 15″, and two vertical pieces fastened to one side, parallel to each other and an inch apart, with holes bored through each at intervals of three inches to the height of about two feet. A fulcrum is then inserted between the two uprights and secured by an iron pin. When the plants are placed beneath and a weight is hung on the outer end the press is complete.

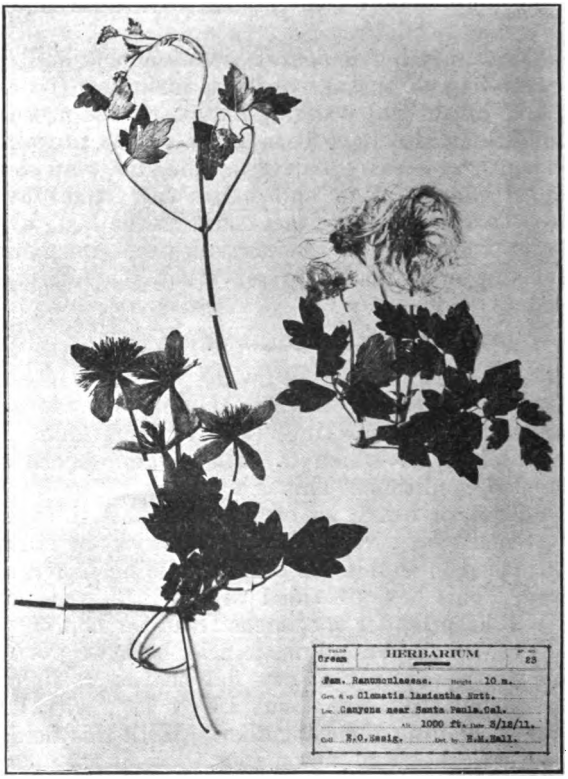

FIG. 137. Specimen of Wild Clematis (*Clematis lasiantha*) correctly mounted and showing the different parts of the plant.

Another very convenient press, which is used extensively, is similar to the field book or portfolio, though of stronger material—two thin boards 16″ x 12″, braced with cross pieces to prevent their warping, and one or two strong, flexible straps. Such a press is often best for the man who collects in spare time, as it can be hung over a stove or radiator and requires very little attention other than to tighten the straps as the specimens dry.

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Driers. The best material for driers is what is known as corrugated pasteboard. It should be surfaced on both sides and should be cut the same size as the portfolio—16″ x 12″. This corrugated board has been adopted by the United States Department of Agriculture and by many of the universities, largely because of the greater ventilation given the pack through the corrugations. In ordering the driers cut, state that the corrugations must run across and not longitudinally, as the shorter the distance the air travels the better the ventilation. They have the added advantage of not requiring as frequent changes as the felt driers formerly in use. The length of time required for drying is also materially reduced, which is a matter of some importance.

When the corrugated pasteboard driers are used in the strap-press it is a good plan to hang it up or stand it on edge, so that the air may more readily pass through the corrugations. In cold, damp weather the press should be placed near the stove or some other means of artificial heat.

The other form of drier is felt paper. It is a good plan to have a few of these driers on hand in case specimens containing a great deal of moisture are collected. The corrugated board does not absorb moisture as the felt does, serving merely as an aid in evaporation.

Floating Pan. This is a receptacle used for spreading water specimens such as fresh water algæ, seaweeds, and other small plants which are difficult to spread by other means.

Microscope. For ordinary field purposes a small hand lens is the best magnifier to use. Such a lens can be bought very cheaply. For the laboratory and for all careful work a dissecting microscope is necessary. This is not an expensive instrument, the prices ranging from $2.50 to $50. It is invaluable for examining not only floral parts but also diseased plants and insects. Complete laboratory equipments of glass slides, cover glasses, dissecting needles, forceps, a camels-hair brush and small magnifying glass can be obtained from any laboratory supply house for between $2 and $3. This laboratory equipment is a very valuable addition to any horticultural or agricultural office. It is impossible to do good work without it.

Herbarium Sheets. Paper for the final mounting of specimens should be white, glazed, bristol board, standard size, 15″ x 11″. Covers should be of heavy manila paper, large enough so that when folded they will be 15¼″ x 11¼″ or a fraction larger than the specimen sheet. If it is not the intention of the collector to mount his specimens a very satisfactory white paper can be obtained from the local news dealers at a small cost. These papers should be double width and should be folded to receive the specimens. In either case the manila paper should be used for the outer cover.

Labels. These are of varying design and are filled out in varying degrees of detail. In general a good label should convey the following information: 1. Family, genus, species, variety (names to be determined by collector or some one for him at a later date); 2. Common name of plant as known in its locality; 3. Locality; 4. Date; 5. Kind of soil, as woods, rocks, meadows, marsh, sand, etc.; 6. Approximate elevation of place, as foothill or plain; 7. Notes (the uses, characters, color of

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flowers, or other information not directly revealed by the specimen); 8. Collector's name; 9. Name of the person determining the scientific name of the specimen.

If a notebook is carried it is often a good plan simply to number each specimen and file data in the notebook after the corresponding number. These numbers should never leave the plant until the data is transcribed and ready to attach. A plant is not worth nearly as much to the herbarium without reliable data as to the time and place of collection.

FIG. 138. Specimen of blue-eyed grass (*Sisyrinchium bellum*) arranged to show the entire plant as it appears in nature. See also cut of the greater Ragweed.

The instructions regarding labels apply also to plants or insects sent in for identification. Frequently two species will look very much alike but will be found in different localities. This is especially true of insects. It is very difficult—often impossible—to give good advice when details regarding locality, etc., are inadequate.

Seed Vials. Collections of seeds are perhaps best preserved in small bottles or vials of the wide-mouth type. Shallow drawers or exhibit cases should be provided with divisions so the vials can be laid horizontally to show both the contents and the label. The size of these

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bottles can be varied according to the nature of the material to be preserved. As a rule, however, a two or three dram size is preferred and uniformity in size adds considerably to the appearance of the collection.

Seeds also can be mounted for exhibition and distribution in glass covered plaques. For this purpose use old photographic plates (cleaned by boiling for a few minutes in soapy water) and two thicknesses of pasteboard. The first board should be punched with inch or half-inch holes then pasted to the second board. After the seeds have been placed in the holes and properly labeled the glass is placed over them and the whole bound together with strips of gummed paper or passepartout.

The following is an extract from Bulletin 39 of the Smithsonian Institute, by F. H. Knowlton, on collecting plants:

"It is an art to collect plants properly. As regards their collection, plants may be divided into two general classes—herbaceous and shrubby plants. All herbs of modern size and height should be collected entire. It is not sufficient to break or cut them off at such a point on the stem as will insure a specimen of the proper length. Every part of a plant has a character of its own and one which should be represented in the collection. The leaves of most herbs vary in form at different points on the stem, and the same is generally true of the degree of pubescence, which is a character of the first importance. Even the dead leaves about the base are distinctive and should never be torn off. If radical leaves exist, they should be collected with great care, and to secure these it is often necessary to collect them at a different time of the season from that in which the flowers are obtained. No part of the plant is more characteristic than its root. It must not be forgotten that every plant, except epiphytes and parasites, has a subterranean as well as an aerial portion and where only one is exhibited only half of the plant is represented. Of course there are many plants, even herbaceous ones, whose roots can not be reduced to dimensions adapted to a herbarium but wherever it is possible the entire specimen, root and stem, should be secured. Much larger plants may thus be collected than is often supposed possible, as will be explained presently.

"For large herbs with spreading branches the best that can be done is to collect the flowering portions in specimens of suitable size and supplement them with leaves selected from lower parts of the stem.

"As regards shrubby plants and trees, the flower and leaf-bearing twigs should be collected and if the leaves vary on different parts of the plant the different forms should be collected. Occasionally it is desirable to strip off a portion of the bark as a distinctive part of the species in question.

"The representative parts of every plant are flowers, fruit and leaves, and no specimen can be regarded as complete without all these parts. Often, as in many Cruciferæ, all these can be found combined in the same specimen at once but in most cases it requires at least two separate collections at different times in the season. When fruit can be found attached to the stem and leaves, this is of course the preferable way, since it leaves no possible doubt as to the identity of both.

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This should therefore be done as long as the size of the fruit will permit, and is recommended in the case of all acorns and even in hickory nuts. In the case of larger fruits, such as the walnut (Juglans), the crab apple, or the persimmon, the fruit can be collected separately."

The length of a specimen should not be over 15 inches, as that is the length of the mounting sheets. Grasses, reeds and other long plants which are easily bent can be folded to the proper length. This should be done at the time they are put into the portfolio and even when placed in the vasculum they should be bent in the manner later intended for pressing.

Many wiry herbs and shrubs can be bent to fit into the press but will not retain their bent position when released from the hand. Such plants can be managed by slipping the bent end through a slit piece of paper.

There is only one correct way to bend long specimens to fit the herbarium sheet. Start with the root at the lower left hand corner of the sheet and make the first angle at the top of the sheet. The second angle will then be made at the bottom and the plant should form the letter N. If a third bend is necessary it should form the letter M and so on. This method gives a neater appearance to specimens than can otherwise be obtained.

Care should be taken in removing roots. For this a small trowel or a large knife is the best implement to use. Where it is impossible to take the root, dig away the ground so as to examine a portion of it and put a brief description in the notes.

In collecting ferns save two or more leaves so that when mounted both upper and lower surfaces can be shown.

Put plants in the vasculum or the field book as soon as possible, in order to prevent wilting and always with locality and field notes attached. This is an important point. It is surprising how much can be forgotten between field and laboratory.

Algæ and other small water plants are better kept in a bottle as they dry very rapidly and are hard to revive.

PRESSING.

The sooner plants can be taken from the vasculum the better. Lay the specimens out as naturally as possible between sheets of newspaper. Do not try to spread branches that should not spread naturally. Do not turn flower heads erect which ordinarily droop. If the leaves are all on one side of the stem let them remain in their natural position as far as possible. Do not overcrowd specimens and do not let them overlap when it can be avoided, for when they dry they will stick together and attempts to separate them will probably result in tearing.

The grasses which have been folded should be placed in the press in such a manner that no ends project. Plants which are too large to fold can be cut into sections, numbered and placed consecutively. Roots which are too heavy to press can be sectioned, leaving one side to show the general character of the surface. Place each newspaper between driers before putting in press.

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Thin, flat boards should be placed at intervals in the pack, in order to insure more uniform pressure. When put under the press use light pressure for the first day or so. If the felt driers are used change them frequently, both to prevent moulding and to hasten the drying. The faster floral specimens dry the better they will retain their color. Where the corrugated board is used it is not necessary to change them so often. In general it is advisable to change either drier at least twice in the first twenty-four hours. Leave in the press until thoroughly dry, then tie with cord, date and set aside till time can be had for mounting.

Always see that the driers are aired and clean, as many specimens are ruined by stains and moulds which are the result of mishandling.

When plants have once been put in the press the newspapers covering them should not be removed until they are dry. The bruises caused by the press will quickly turn brown upon exposure to the air. The flowers also have a tendency to become dull and turn brown unless handled very carefully.

MOUNTING.

There are two methods of mounting plant specimens, either one of which is good. The first is known as the glue method. For this it is necessary to have a flat-bottomed pan larger than the specimens to be mounted, or a piece of window glass, and a pot of inexpensive glue—preferably Le Page's diluted. The glue is spread with a brush in a thin layer over the glass and the plant laid upon it. Light pressure should be applied at the contact points to insure their being well coated.

The position the specimen is to occupy on the sheet should be determined before it is dipped in the glue. After dipping it is placed on the sheet and set to one side. Put a drier over it and continue with the next, piling them on top of each other as finished. A weight should be placed on them overnight, and in the morning they will be ready for filing. Do not omit to place the labels with each specimen. The permanent labels should be affixed to the lower right hand corner of the mounting sheet.

The second method is called the strip method. It consists of fastening the principal parts of the specimen to the sheet by means of tiny strips of gummed paper or surgeons' silk. This gummed paper can either be made at home or bought in bulk and used as needed.

In general, it is best to use no more fastening than is necessary to hold the plant firmly. Strips should be small and should be put on as neatly and uniformly as possible. The points most in need of fastening are the base, the center, and the head. A lateral branch which is apt to be broken should also be fastened.

The question at once arises: How many specimens shall be put on one sheet? A good rule to follow is to use enough material to present a good appearance without crowding. Never put more than one species on the same sheet, and never put away a sheet without the label.

HERBARIUM.

There are two generally accepted ways of keeping a herbarium: One is to place the classified plants in neat, white folders, putting each species in a separate sheet and all the species of a genus into a larger

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cover, usually of manila paper, and called a "genus cover." This is by far the easiest and most practical method for the botanist who collects for pleasure, or for the commissioner whose collection finds its value in its ready accessibility and not in its beauty or rare species. To prevent the specimens from sliding out of the folders the species covers usually are placed with their openings opposite that of the genus cover.

The other method is to mount each specimen on a separate sheet of glazed paper, bristol board, size 11" x 15". This is the method used in all the large herbariums in the United States and has obvious advantages over the other where rare specimens are to be cared for.

A botanist's collection always consists of two departments: The herbarium proper and the duplicates. The former he arranges in strict botanical order, sees to it that it contains a perfect specimen fully representing every plant he has ever collected, and adds to it as many other plants as he is able to obtain through the process of exchanging, or in any other way. The latter contains a large number of specimens of each of the rarer plants of his local flora, and eventually he will add to it other rare plants obtained from other sources. It does not aim at completeness but simply to supply a foreign demand and serve as a means of increasing and enriching his herbarium proper.

Permanent Labels. After the plants are mounted they are ready for permanent labels. These are affixed to the lower right hand corner and can either be printed forms or blanks bearing only the collector's name at the top. The labels should not be fastened down too solidly, for it may be desirable to make changes as new knowledge is secured. It is therefore best to gum the upper edge only.

The plants are now ready for filing and should be entered, as stated on a previous page, in genus cover, numbered and filed in perfect order. It matters little whether the order is numerical or based on classification but the arrangement should be systematic, as otherwise the collection will soon become cumbersome and unsatisfactory.

Cabinets or drawers can be used for filing, according to the taste or convenience of the collector. Personally the writer prefers a pigeonhole cabinet with glass or wooden doors. The pigeonholes should be just wide enough to receive the genus sheet and about 8 inches high each. A very considerable herbarium can be filed in this way in a small space. The cabinets can be built as high as desired and need not be over 18 inches deep.

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LAWS PERTAINING TO WEED CONTROL.

By W. S. WILKINSON, JR., Sacramento, California.[1]

There are certain laws, both of the United States and of the State of California which have as their purpose the control of weeds and the prevention of their introduction and spread especially in areas which are not now infested. Of these laws the following are of primary importance:

UNITED STATES SEED IMPORTATION ACT.

The United States Seed Importation Act was passed by Congress on August 24, 1912, and amended August 11, 1916. The law as amended applies to seeds which are imported into the United States from states or countries without the United States.

In addition to the text of the law rules and regulations governing the importation of seed have been promulgated by the Secretary of Agriculture, Washington, D. C., and the Secretary of the Treasury. These clarify and supplement the law. Copies may be obtained upon application to the Seed Laboratory, Department of Agriculture, Sacramento, California.

CALIFORNIA LAWS.

The California laws, as would be expected, refer to conditions as found in the state. They propose not only the prevention of the spread of weeds but also the control and eradication in infested districts. Excerpts of the laws follow:

DEPARTMENT OF AGRICULTURE ACT, 1921.

Chapter 606 of the Statutes of 1921 annuls section 361 of the Political Code of California and reads in part as follows:

"A department of the government of the State of California to be known as the department of agriculture is hereby created" * * *.

Section 361*b* states, "The department of agriculture except as in this act otherwise provided shall succeed to and is hereby invested with all the duties, powers, responsibilities and jurisdiction of the state commissioner of horticulture," * * * and whenever by the provision of any statute in force or that may hereafter be enacted a duty or jurisdiction is imposed or authority conferred upon any such bodies, * * * or employees, or upon any other person by any statute, the enforcement of which is transferred to the department, such duty, jurisdiction and authority are hereby imposed and transferred to the department of agriculture and the appropriate officers thereof * * *.

Section 361*c*. "The department of agriculture is hereby invested with the power and is charged with the duty of administering and enforcing the following laws: * * *"

An act to prevent the propagation by the production of seed of that certain plant known as *Sorghum halepensis*, otherwise known as Johnson Grass, approved March 2, 1903, and all acts amending or supplementing said acts: * * * State commissioner of horticulture. Section 2319*a* of the Political Code, referring to the state commissioner of horticulture, states: * * * "It shall be the duty of the state commissioner of horticulture to promote and protect the plant industry of this state; to prevent the introduction and spread of injurious insect or animal pests, plant diseases and noxious weeds: * * *."

Section 2319*b* states * * * "Said commissioner may, by and with the approval of the governor, establish, maintain and enforce such quarantine regulations as may be deemed necessary to protect nurseries, trees, shrubs, seeds, vegetables or other articles of horticulture against contagion or infestation by injurious plant diseases, insects or animal or weed pests; * * *."

[1]Seed Specialist, California State Department of Agriculture.

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Section 2319c entire. Upon information received by such commissioner of the existence of any infectious plant disease, insect or other animal or weed pest, new to or not generally distributed within this state, dangerous to any article, or to the interests of the plant industry of this state, or that there is a probability of the introduction of any such infectious plant disease, insect or other animal or weed pests into this state or across the boundaries thereof, he shall proceed to thoroughly investigate same and may establish, maintain and enforce quarantine as hereinbefore provided, and may make and enforce such regulations as are in his opinion, necessary to circumscribe and exterminate such infectious plant disease, insect or other animal or weed pests and prevent the extension thereof. Such commissioner may disinfect, or take such other action with reference to, any trees, shrubs, plants, vines, cuttings, grafts, scions, buds, fruit-pits, fruit, seeds, vegetables or any crops infested or infected with or which, in his opinion may have been exposed to infection or infestation by, any such infectious plant diseases, insect or other animal or weed pests, as in his discretion shall seem necessary to carry out and give effect to the provisions of this act. Such commissioner is hereby authorized to enter upon any ground or premises to inspect the same or to inspect any tree, shrub, plant, vine, cutting, graft, scion, bud, fruit, seed, vegetable, or other article of horticulture or implement thereof or box or package pertaining thereto or connected therewith or that has been used in packing, shipping or handling the same, and to open any such package, and generally to do, with the least injury possible under the conditions to property or business, all acts and things necessary to carry out the provisions of this chapter; *and provided, however*, that whenever any nursery or other premises whereon are being grown for planting or propagation purposes any nursery stock, trees, plants, shrubs, vines or seeds is found to be infested or infected with any insect or other animal pest or plant disease not generally distributed over the state and which, in the opinion of the state commissioner of horticulture, would cause damage or be liable to cause damage to the orchards, vineyards, gardens or farms of any portion of this state, the owner or person in charge of such premises shall be notified in writing to that effect by the state commissioner of horticulture. Such written notice shall include the name or names of the insects or other animal pests or plant diseases, and known host plants thereof, together with the best known means of eradicating or controlling such insects or other animal pests or plant diseases, and it shall be unlawful knowingly to sell, offer for sale, ship or deliver for shipment the host plants of, or seeds infested or infected with, any such insect or other animal pests or plant diseases. When in the opinion of the state commissioner of horticulture such insect or other animal pests or plant disease has been eradicated or satisfactorily controlled, he shall in writing release such host plants or host seeds for sale or shipment. (Amended Stats. 1919, p. 256.)

COUNTY HORTICULTURAL COMMISSIONER ACT.

The provisions of the County Horticultural Commissioner Act deal specifically with the control and eradication of weeds in infested areas. Sections of this law follow:

Section 2322. Whenever a petition is presented to the board of supervisors of any county or city and county, and signed by twenty-five or more persons each of whom is a resident freeholder and possessor of an orchard, or greenhouse or nursery, or rice fields, stating that certain or all orchards or nurseries or trees or plants of any variety or rice fields, are infested with any infectious diseases, or insects of any kind injurious to fruit, fruit trees, vines or other plants or vegetables, or that there is growing therein the Russian thistle or saltwort (*Salsola kali* var. *tragus*), Johnson grass (*Sorghum halepense*) or other noxious weeds, or red rice, or water-grasses or other weeds or grasses detrimental to rice culture, codlin moth or other insects, ground squirrels, gophers or other animals that are destructive to trees and plants; or that serious pests, plant diseases, injurious to fruit, fruit trees, vines, or other plants or vegetables, or noxious weed seed are being shipped into the county which would cause damage or be liable to cause damage to the orchards, vineyards, gardens or farms of the county or state; and praying that a commissioner be appointed by them whose duties shall be to supervise the eradication, the control, or the destruction of said insects, ground squirrels, gopher or other animals, diseases or Russian thistle or saltwort, Johnson grass or other noxious weeds or red rice, water-grasses or other weeds or grasses detrimental to rice culture, when growing in fields of rice or fields adjacent thereto, or in canals or ditches used for the purpose of conveying water to rice fields for the irrigation thereof, as herein provided, the board of supervisors shall immediately notify the director of agriculture to furnish them a list of names of persons eligible to the position of county horticultural commissioner and from such list the said supervisors shall appoint a commissioner in accordance with the provisions of this chapter, whose term of office shall be for four years and until his successor shall be appointed and qualified and who shall give bond in the sum of one thousand dollars for the faithful performance of his duties.

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2322*a*. (1) It shall be the duty of the county horticultural commissioner in each county, whenever he shall deem it necessary to cause an inspection to be made of any premises, orchards or nurseries, or trees, plants, vegetables, vines or fruits, or any fruit-packing house, storeroom, salesroom, or any other place or article in his jurisdiction, and if found infected or infested with infectious diseases, scale insects, Argentine ants, or codlin moth, or other insect or animal pests injurious to fruits, plants, vegetables, trees or vines, or with their eggs or larvae, or if there is found growing thereon the Russian thistle or saltwort, Johnson grass or other noxious weeds, or red rice, water grasses or other weeds or grasses detrimental to rice culture, he shall in writing notify the owner or owners, person or persons in charge, or in possession of the said places or orchards or nurseries, or trees or plants, vegetables, vines, or rice fields adjacent to rice fields, or canals or ditches used for the purpose of conveying water to rice fields for the irrigation thereof, or fruit, or article as aforesaid, that the same are infected or infested with said diseases, insects, animals or other pests, or any of them or their eggs or larvae, or that the Russian thistle or saltwort, Johnson grass or other noxious weeds, or red rice, water grasses or other weeds or grasses detrimental to rice culture, is growing thereon, and require such person or persons, to eradicate, or destroy or to control to the satisfaction of the county horticultural commissioner the said insects, animals or other pests, or their eggs or larvae, or Russian thistle or saltwort, Johnson grass or other noxious weeds or red rice, or water grasses or other weeds or grasses detrimental to rice culture, within a certain time to be therein specified. Said notices may be served upon the person or persons, or either of them owning or having charge, or having possession such infested place or orchard or nursery, or trees, plants, vegetables, vines, or fruit, or articles, as aforesaid, or premises where the Russian thistle or saltwort, Johnson grass or other noxious weeds or red rice, water grasses, or other weeds or grasses detrimental to rice culture shall be growing, or upon the agents of either, by any commissioner or by any person deputed by the said commissioner for that purpose in the same manner as a summons in a civil action.

(2) In case infectious diseases, scale insects, codlin moth, or other insect or animal pests injurious to fruit, plants, vegetables, trees, or vines, or their eggs, or larvae, are found to exist on trees or shrubs in public parks or along streets, highways, or other property subject to the control of a city or county government, or if there is found growing in any public park, street, highway, or on other property subject to the control of a city or county government any Russian thistle, or saltwort, Johnson grass, or other noxious weeds, or red rice, water grasses, or other grasses detrimental to rice culture, when said public park, street, highway, or other property subject to the control of the city or county government is adjacent to rice fields, or canals or ditches used for the purpose of conveying water to rice fields for the irrigation thereof, then said notice in writing shall be served on the chairman of the governing body of said city or county, and in case the work of eradication, or of control, or of destruction of the said pests, diseases, or noxious weeds in the said public parks, streets, highways, or other public property shall be performed by the county horticultural commissioner, then the cost thereof shall become a city or county charge, as the case may be, and shall be paid from the general fund of said city or county; *provided, however*, that if any such infected or infested articles, property or premises as hereinabove specified belong to any person who is not a resident of the county, and there is no person in control or possession thereof, and such nonresident person has no tenant, bailee, depositary or agent upon whom service can be had; or if the owner or owners of any such articles, property or premises can not after due diligence be found, then such notice may be served by posting the same in some conspicuous place upon such article, property or premises, and by mailing a copy thereof to the owner thereof at his last known place of residence, if the same is known or can be ascertained; or if not known then to the county seat of the county wherein said property is situated.

(3) Any and all such places, or orchards, or nurseries, or rice fields or fields adjacent to rice fields, or canals or ditches used for the purpose of conveying water to rice fields for the irrigation thereof, or trees, plants, shrubs, vegetables, vines, fruit, or articles thus infested or infected, or premises where the Russian thistle or saltwort or Johnson grass or other noxious weeds, or red rice, water grasses, or other weeds or grasses detrimental to rice culture or where any squirrels, gophers or other predatory animals shall be found, are hereby adjudged and declared to be a public nuisance; and when and whenever any such nuisance shall exist at any place within this county, and the proper notice thereof shall have been served as herein provided, and such nuisance shall not have been abated within the time specified in such notice, it shall be the duty of the county horticultural commissioner to cause said nuisance to be at once abated, by eradicating, or by controlling, or by destroying said diseases, insects, animals or other pests, or their eggs, or larvae, or Russian thistle or saltwort, or Johnson grass or other noxious weeds, or red rice, water grasses, or other weeds or grasses detrimental to rice culture.

(4) The expense thereof shall be a county charge, and the board of supervisors shall allow and pay the same out of the general fund of the county; any and all

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sums so paid, together with interest thereon at the rate of seven per cent per annum, shall be and become a lien on the property and premises from which said nuisance has been removed or abated in pursuance of this chapter. Notice of such lien shall be filed and recorded in the office of the county recorder of the county in which the said property and premises are situated within thirty days after the right to the said lien has accrued and a copy of said lien shall be mailed to the person or persons who appear of record to be the owners of any mortgage, trust deed, lien, contract, option, or other incumbrance on said property, at the last known place of residence of said incumbrancer, and if the place of said incumbrancer be unknown to said county horticultural commissioner, then said fact shall be stated in said copy so mailed and it shall be addressed to the county seat of the county wherein said property is situated. Such lien shall take precedence over and be paramount to all mortgages, trust deeds, liens, contracts, options, bonds, or other incumbrances upon the land excepting only the lien of taxes. If said sum secured by such lien be not repaid to said county within eighty days from the filing of said notice of lien then and there shall be added to the same and secured by such lien a penalty of fifteen per cent on the amount of said lien. An action to foreclose said lien shall be commenced within ninety days after the filing and recording of said notice of lien, which action shall be brought in the proper court by the district attorney of the county in the name and for the benefit of the county making such payment or payments, and when the property is sold, enough of the proceeds shall be paid into the county treasury of such county to satisfy the lien and costs; and the overplus, if any there be, shall be paid to the owner of the property, if he be known, and if not, into the court for his use when ascertained.

(6) The county horticultural commissioner is hereby vested with the power to cause any and all such nuisances to be at once abated in a summary manner.

2322*f*. Any person, persons, firm or corporation, who shall receive, bring, or cause to be brought into any county or locality of the State of California from another county or locality within said state any nursery stock, trees, shrubs, plants, vines, cuttings, grafts, scions, buds, or fruit pits, or fruit or vegetables or seed, for the purpose of planting or propagating the same, or any or all such shipments of nursery stock, trees, shrubs, plants, vines, cuttings, grafts, scions, buds, or fruit pits, or fruit or vegetables, or seed containers thereof or other orchard appliances, which the county horticultural commissioner or the state commissioner of horticulture may consider liable to be infested or infected with dangerous insect pests or plant diseases or noxious weed seeds and which if so infested or infected would constitute a dangerous menace to the orchards, farms and gardens of the county or state, shall immediately after the arrival thereof notify the county commissioner of horticulture, his deputy, or nearest inspector of the county in which such nursery stock, or fruit or vegetables, or seed are received, of their arrival, and hold the same without unnecessarily moving or placing such articles where they may be harmful, for immediate inspection by such county commissioner of horticulture, his deputy, inspector, or deputy quarantine officer or guardian. (Added Stats. 1917, p. 635.)

2322*g*. Each carload, case, package, crate, bale, or bundle of trees, shrubs, plants, vines, cuttings, grafts, scions, buds, fruit pits, or fruit or vegetables or seed, imported or brought into any county of the State of California from another county within said state for planting or propagation purposes, shall have plainly and legibly marked thereon in a conspicuous manner and place, the name and address of the shipper, owner or owners, or person forwarding or shipping same, and also the name of the person, firm or corporation to whom the same is forwarded or shipped, or his or its responsible agents. A manifest showing the contents of each shipment, also the name of the locality where the contents were grown and a statement of the contents therein shall be made to the county horticultural commissioner having jurisdiction at the point of destination when shipment is made. (Added Stats. 1917, p. 636.)

2322*h*. When any shipment of nursery stock, trees, vines, plants, shrubs, cuttings, grafts, scions, buds, fruit pits, or fruit or vegetables or seed imported or brought into any county or locality of the State of California from another county or locality within such state is found to be infested or infected with any species of injurious insects, or their eggs, larvae or pupae, or other animal or plant diseases or noxious weed seeds which would cause damage or be liable to cause damage to the orchards, vineyards, gardens or farms of any county of the State of California, all material in shipment found to be infested or infected shall be deemed a public nuisance, shall be refused delivery, and shall be immediately returned to the point of shipment or destroyed, at the option and expense of the owner or owners, or his or their responsible agents. The remainder of such shipment shall be disinfected under the directions of the county horticultural commissioner making such inspection and in a manner as provided for in section two thousand three hundred and twenty-two of this act; *provided, however*, that when any shipment of nursery stock, trees, vines, plants, shrubs, cuttings, grafts, scions, buds, fruit pits, or fruit or vegetables, or seed or their containers or orchard appliances imported or brought into any county or locality of the State of California from another county or locality within

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said state, is found to be infested or infected with any species of injurious insects, or their eggs, larvae, or pupae, or any other injurious animal or plant diseases or noxious weed seeds not known to exist in the county or locality in which said shipment is delivered, or if there is reasonable cause to presume it may be so infested or infected the entire shipment shall be refused admittance and shall immediately be returned to point of shipment or destroyed at the option and expense of the owner or owners, or his or their responsible agents; *provided, further*, that when any nursery stock, trees, vines, plants, shrubs, cuttings, grafts, scions, buds, fruit pits, or fruit or vegetables, or seed, imported or brought into any county or locality of the State of California from another county or locality within said state is found to be infested or infected with any species of injurious insects or their eggs, larvae, or pupae, or plant diseases or noxious weed seeds which are of common occurrence in the county or locality into which it is shipped or transported, and which may be exterminated by such treatment as may be prescribed in section two thousand three hundred and twenty-two *i* of this act and under the direction of the county horticultural commissioner of the county in which it is received, the same may be disinfected or cleaned at the expense of the owner or owners or his or their responsible agents, in a manner satisfactory to the county horticultural commissioner making the inspection, and after such treatment the shipment may be delivered to the consignee. Any and every provision of this act relating to shipment or transportation of nursery stock, trees, shrubs, plants, vines, cuttings, grafts, scions, buds, or fruit pits, or fruit or vegetables or seed from one county of the State of California to another county of said state, shall apply equally and identically to such shipment or transportation of such articles from one locality to another locality within the same county of said state. (Added Stats. 1917, p. 636.)

2322*j*. Any person, persons, firm or corporation violating any of the provisions of this act shall be punished by imprisonment in the county jail for a period not exceeding six months or by a fine not exceeding five hundred dollars, or by both fine and imprisonment. (Added Stats. 1917, p. 638.)

JOHNSON GRASS.

(This law on Johnson grass is now effectively operative only in counties where there is no county board of horticultural commissioners or where there is no county horticultural commissioner.)

An act to prevent the propagation by the production of seed, of that certain plant known as Sorghum halepense, otherwise known as Johnson grass.

(Approved March 20, 1903, Stats. 1903, p. 337. Amended Stats. 1907, p. 876.)

SECTION 1. It shall be unlawful for any person owning, controlling, leasing or possessing land in the State of California, to knowingly permit certain grass known as *Sorghum halepense*, otherwise known as Johnson grass, *Cnicus arvensis*, otherwise known as Canadian thistle, *Salsola kali*, otherwise known as Russian thistle, *Onopordon acanthium*, otherwise known as Scotch thistle, and *Cnicus lanceolatus*, otherwise known as bull thistle, to mature and disseminate its seed on land so owned, leased or possessed by such person. (Amended Stats. 1907, p. 876.)

SEC. 2. It shall be unlawful for any person knowingly to sow or disseminate, or cause to be sown or disseminated, any seed of *Sorghum halepense*, otherwise known as Johnson grass, *Cnicus arvensis*, otherwise known as Canadian thistle, *Salsola kali*, otherwise known as Russian thistle, *Onopordon acanthium*, otherwise known as Scotch thistle, and *Cnicus lanceolatus*, otherwise known as bull thistle, upon any land owned or possessed by another. (Amended Stats. 1907, p. 877.)

SEC. 3. It shall be unlawful for any person to knowingly sow, disseminate, or cause or permit to be disseminated any seed of *Sorghum halepense*, otherwise known as Johnson grass, *Cnicus arvensis*, otherwise known as Canadian thistle, *Salsola kali*, otherwise known as Russian thistle, *Onopordon acanthium*, otherwise known as Scotch thistle, and *Cnicus lanceolatus*, otherwise known as bull thistle, over or along any roadway, highway, or right of way for ditch purposes, adjacent to premises owned or possessed by him. (Amended Stats. 1907, p. 877.)

SEC. 4. Any person upon being duly convicted of a violation of any of the preceding sections of this act, shall be guilty of a misdemeanor, and may be fined in a sum not exceeding one hundred dollars, or by imprisonment in the county jail, for a term not exceeding three months.

(Section 4 of the amendment approved March 22, 1907, reads: "All acts and parts of acts inconsistent with the provisions of this act are hereby repealed.")

SEC. 5. This act shall take effect and be in force from and after its passage.

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In addition to those laws which have been on the statute books, there are two which were enacted at the last session of the legislature of California. These are the Pure Seed Act of 1921 and the Weed Free Area Act.

The purpose of the Pure Seed Act is to cause the labeling of all agricultural seed sold for seeding purposes in California. Thus in causing the labeling of the seed the purchaser may know the kind and condition of the seed he is purchasing. Should the seed contain large amounts of weed seeds or other impurities, he can refrain from buying and in this way eliminate the future task of eradicating the weeds which may grow as a result of the impurities. Copies of the Pure Seed Act may be obtained upon application to the Seed Laboratory, Department of Agriculture, Sacramento, California.

The purpose of the second, the Weed Free Area Law, is to protect those localities which are now or may be made free from weeds from infestation by introducing into such an area, through the medium of impure seed, hay, etc., any reproductive portion of any weed not existant in the area. A copy of this law follows:

WEED FREE AREA ACT.

The people of the State of California do enact as follows:

SECTION 1. The term "noxious weed" as used in this act shall be defined as any of the following species of plants: Johnson grass (*Holcus halepensis*), sand-bur grass (*Cenchrus pauciflorus*), water grass (*Echinochloa crus-galli*), nut grass (*Cyperus* sp.), Russian thistle (*Salsola kali*), tumbling mustard (*Sisymbrium altissimum*), hoary cress (*Lepidium draba*), puncture vine or ground bur nut (*Tribulus terrestris*), creeping mallow (*Sida hederacea*), St. Johnswort (*Hypericum* sp.), morning glory (*Convolvulus arvensis*), dodder (*Cuscuta* sp.), Star thistle (*Centaurea* sp.), Canada thistle (*Cirsium arvense*), creeping sow thistle (*Sonchus arvensis*), Coast dandelion (*Hypochaeris radicata*), and any other weed which the director of agriculture shall declare to be noxious and a menace to agriculture, as hereinafter provided.

SEC. 2. Upon information that any species of plant is a noxious weed and a menace to agriculture, the director of agriculture may declare such species to be noxious and such species shall thereafter be considered noxious within the meaning of this act.

SEC. 3. After having made a practical survey, the director of agriculture may declare that an area within this state is practically free from one or more of the noxious weeds which shall be named in said proclamation and which area thereafter shall be known as a noxious weed free area as to the noxius weeds named therein which names shall be a part of the name of said area. The said director of agriculture may by similar proclamation change the boundaries of said area or declare said noxious weed free area free from additional noxious weeds, naming the same. Such proclamations shall be under the seal of the department of agriculture and shall be published and circulated in the area to be affected by said proclamations for two successive weeks, and if there is no such newspaper or farm journal published and circulated in such areas, then said publication shall be made in a newspaper or farm journal published and circulated in the county in which such area is situated; and a copy of said proclamation shall be posted in one or more public places in said area.

SEC. 4. It shall be unlawful for any person, firm or corporation to sell, distribute or offer or expose for sale or distribution, or transport into or to sow or disseminate or cause to be sown or disseminated in any noxious weed free area any seed, bulb, tuber, shizome or other reproductive part of any noxious weed, either singly or in combination or as an impurity in any commercial seed, which has been declared to be practically nonexistent in such noxious weed free area.

SEC. 5. It shall be unlawful for any railroad, canal, ditch or water company, or any person, firm or corporation owning, possessing, leasing, controlling or occupying lands in such noxious weed free area to permit any noxious weed named in said proclamation to mature and disseminate its seeds thereon, or for more than two successive years to reproduce itself thereon by crowns, underground stems, buds, or any other vegative means whatsoever.

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SEC. 6. The duty of enforcing this act and carrying out its provisions shall be vested in the director of agriculture. The said director of agriculture shall be empowered to adopt such rules and regulations as may be deemed necessary to carry out the provisions of this act.

SEC. 7. Any person, firm or corporation who shall violate any provision of this act shall be guilty of a misdemeanor.

SEC. 8. If any section, subsection, sentence, clause or phrase of this act is for reason held to be unconstitutional, such decision shall not affect the validity of the remaining portions of this act. The legislature hereby declares that it would have passed this act, and each section, subsection, sentence, clause or phrase thereof, irrespective of the fact that any one or more sections, subsections, sentences, clauses or phrases be declared unconstitutional.

While the laws are quite explicit and severe, yet alone they could not accomplish the end desired. The control of weeds requires both the laws to regulate the careless and the full cooperation of all parties in any way connected with the agriculture of the state.

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EDITOR'S NOTE.—Paging shown in index refers to paging at bottom of page. Page references at top represent consecutive paging of the Monthly Bulletin. For the convenience of agricultural students, all references to "plant anatomy" are shown in bold-faced type. [Bronte A. Reynolds.]

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